DOCUMENT RESUME

ED 181 266 CE 023 778

TITLE Tractor Mechanics. Maintaining and Servicing the Cooling System, Learning Activity Packages 34-40: Maintaining and Servicing Hydraulic Systems, Learning Activity Packages 41-48.

INSTITUTION Clemson Univ., S.C. Vocational Education Media Center.; Kentucky State Dept. of Education, Frankfort. Bureau of Vocational Education.; Kentucky Univ., Lexington. Div. of Vocational Education.

SPONS AGENCY South Carolina State Dept. of Education, Columbia. Vocational Agriculture Section.

PUB DATE 79

NOTE 83p.: Small print contained in some of the diagrams may not reproduce well: For related documents see CE 023 777-778 and ED 171 933

EDRS PRICE MF01/PC04 Plus Postage.

DESCRIPTORS Agricultural Education: *Agricultural Engineering; Agricultural Machinery: Engines: *Farm Mechanics (Occupation): *Hydraulics: Individualized Curriculum; Individualized Instruction: Learning Activities; Learning Modules; Machinery Industry; *Maintenance; *Tractors; *Vocational Agriculture

ABSTRACT

This series of learning activity packages focuses on two areas of tractor mechanics: (1) maintaining and servicing the cooling system and (2) maintaining and servicing hydraulic systems. Each of the fifteen illustrated learning activity packages follows a typical format: introduction, directions, objectives, learning activities, tools and equipment needed, materials and supplies needed, safety, instructions, student self-check, check-out activities, and final instructor checklist. (LRA)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

CE

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

E. L. Knight

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

TRACTOR MECHANICS

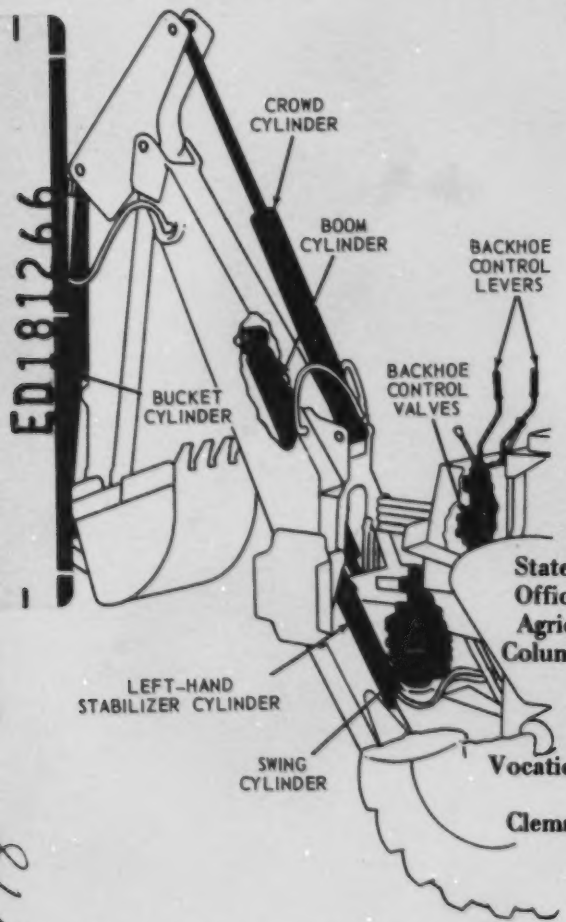
MAINTAINING AND SERVICING THE COOLING SYSTEM

LEARNING ACTIVITY PACKAGES 34 - 40

MAINTAINING AND SERVICING HYDRAULIC SYSTEMS

LEARNING ACTIVITY PACKAGES 41 - 48

ED181266



Courtesy of John Deere and Company

State Department of Education
Office of Vocational Education
Agricultural Education Section
Columbia, South Carolina 29201

In Cooperation With

Vocational Education Media Center
Clemson University
Clemson, South Carolina 29631

1979

THIS MATERIAL WAS ORIGINALLY DEVELOPED BY
THE DEPARTMENT OF VOCATIONAL EDUCATION, COLLEGE OF EDUCATION,
UNIVERSITY OF KENTUCKY AND THE BUREAU OF VOCATIONAL EDUCATION,
KENTUCKY STATE DEPARTMENT OF EDUCATION.
IT HAS BEEN MODIFIED AND REPRINTED WITH THE
PERMISSION OF THE AFOREMENTIONED DEVELOPERS.

Learning Activity Package Number	Objective Numbers	Learning Activity Package Title
DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM		
34.	48	Testing Coolant
35.	47, 49	Testing the Cooling System Pressure
36.	42	Cleaning the Cooling System
37.	43, 50	Servicing a Thermostat
38.	44	Replacing a Radiator Hose
39.	46	Replacing a Fan Belt
40.	45	Replacing a Water Pump
DUTY: MAINTAINING AND SERVICING HYDRAULIC SYSTEMS		
41.	147	Testing the Hydraulic System
42.	143, 144, 145	Maintaining Fluid in the Hydraulic System
43.	54, 57, 59, 153	Servicing a Hydraulic Pump
44.	151, 159	Servicing Hydraulic Valves and Fittings
45.	149	Servicing Hydraulic Cylinders
46.	155	Servicing Hydraulic Motors
47.	148, 152, 160	Servicing Hydraulic Assist Transmissions
48.	156	Servicing Hydraulic Drive Pump and Motors

FEB 1 3 1980

Learning Activity Package Number 34

Courtesy of the John Deere and Company

Testing Coolant

Tractor Mechanics

Objective no. 48

INTRODUCTION

Most tractors use liquid-cooled engines. These are commonly called water-cooled engines, but the coolant solution is usually only part water. An anti-freeze solution is necessary for winter operation. Most manufacturers recommend the use of a combination anti-freeze, anti-boil solution at all times. When changing the coolant, adding coolant to correct the radiator level, and when preparing the tractor for cold weather, the coolant strength should be tested. In this learning activity package you will learn to test the coolant with a hydrometer.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to do this task, turn to p. 2 and go through the Learning Activities in the order given.

OBJECTIVE

Using the designated tractor and a hydrometer, test the radiator coolant solution. The reading should be within one gradation of the instructor's reading on the hydrometer scale.

LEARNING ACTIVITIES

1 READ *Fundamentals of Machine Operation: Preventive Maintenance* (Deere & Company), pp. 78-79, 81-82.

(or)_____

2 CHECK YOUR KNOWLEDGE of testing coolant by taking Student Self-Check, TESTING COOLANT.

3 STUDY the manufacturer's service manual for the hydrometer.

(or)_____

4 READ INSTRUCTIONS, TESTING COOLANT.

(or)_____

5 PRACTICE filling and reading a hydrometer.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

Hydrometer

MATERIALS AND SUPPLIES NEEDED

Radiator Coolant

SAFETY

Use caution if engine is hot when removing radiator cap.

INSTRUCTIONS

TESTING COOLANT

In testing coolant, the following procedure should be used:

1. Remove radiator cap CAREFULLY. (CAUTION: Never remove the radiator cap until the coolant temperature is cooled well below the boiling point. Then loosen the cap only to the first stop to relieve pressure before removing the cap completely.)

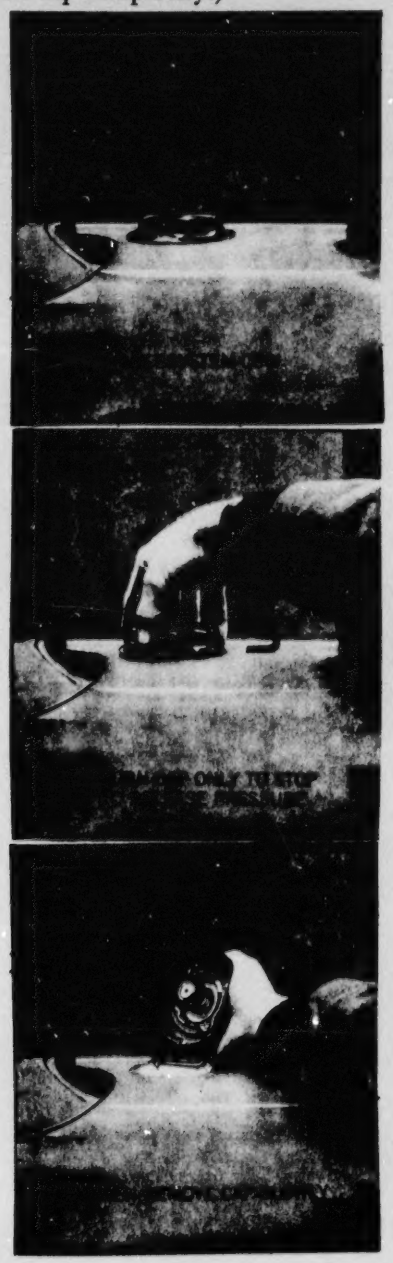


Figure 1. Removing radiator cap.

Courtesy of John Deere and Company

2. Insert hydrometer and draw enough coolant into hydrometer to get a reading. (Be sure float is not sticking.)

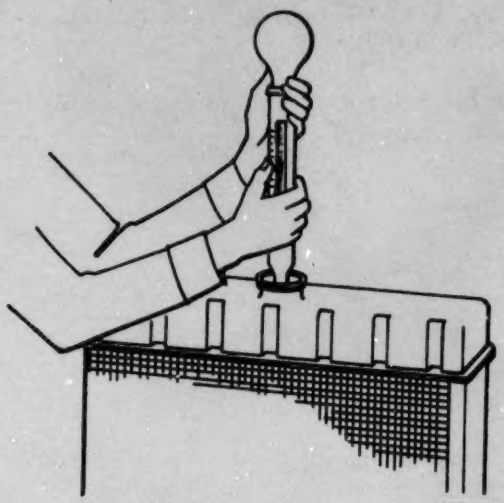


Figure 2. Checking Freezing Protection Using A Hydrometer

Courtesy of John Deere and Company

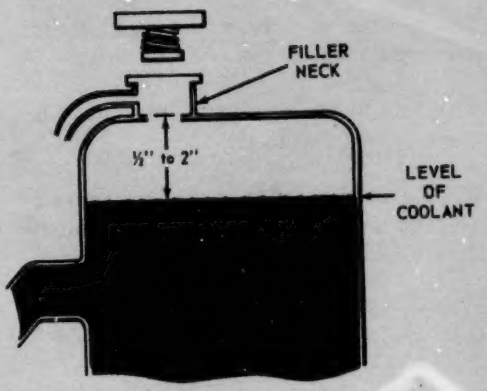


Figure 3. Proper Level of Engine Coolant In Radiator

Courtesy of John Deere and Company

3. Take reading and make correction for temperature variation to determine coolant strength.

4. Return coolant to radiator.

5. Record hydrometer reading.

6. Flush hydrometer with clean water. (CAUTION: You should never pour cold water into a hot engine since it could result in a cracked cylinder head or block. An engine should never be operated without water for even a few minutes.)

7. Check the water level in the radiator. See Figure 3.

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
TESTING COOLANT

Answer the following:

1. The coolant level should be_____inches below the neck of the radiator tank.

2. Why should the cooling system never be completely filled to the top?

3. Which of the following instruments is used to test the freezing protection of the coolant?

   a. Dynamometer
   b. Micrometer
   c. Hydrometer
   d. Hygrometer
   e. Tachometer

4. What may happen if you pour cold water into a hot engine?

5. Why should antifreeze never be mixed (alcohol and ethylene glycol)?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK–OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, TESTING COOLANT.

Test the radiator coolant in the designated tractor.

CORRECT RESPONSES

1. 1/2 to 2 inches
2. The pressurized system needs space for heat expansion without overflowing.
3. c
4. You might crack the head or cylinder block.
5. The freezing protection reading will not be accurate.

DO NOT WRITE ON THIS PAGE

LAP TM–34

Student _____

Date _____

TESTING COOLANT

Instructor's Final Checklist

Check the student's performance in the following elements of testing coolant.

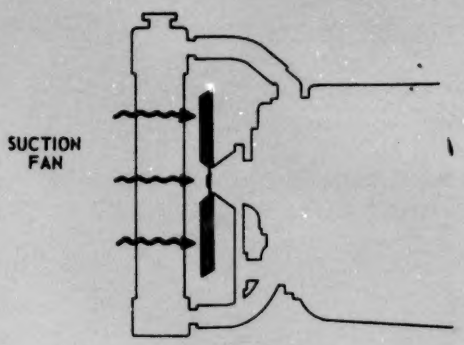
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

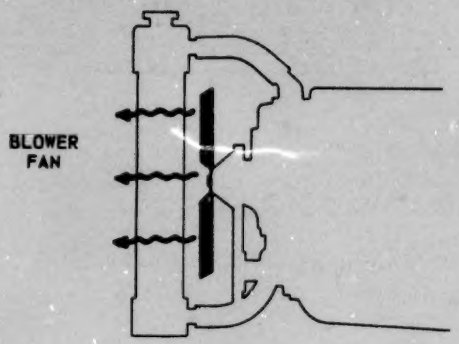
Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In testing radiator coolant, the student:

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	removed the radiator cap	[ ]	[ ]	[ ]	[ ]
2.	drew the correct amount of coolant into the hydrometer	[ ]	[ ]	[ ]	[ ]
3.	took a float reading	[ ]	[ ]	[ ]	[ ]
4.	took a temperature reading	[ ]	[ ]	[ ]	[ ]
5.	determined the coolant strength	[ ]	[ ]	[ ]	[ ]
6.	returned coolant to the radiator	[ ]	[ ]	[ ]	[ ]
7.	recorded reading	[ ]	[ ]	[ ]	[ ]
8.	flushed the hydrometer with clear water	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 35





Testing The Cooling System Pressure

Courtesy of the John Deere and Company

Tractor Mechanics

Objective nos. 47,49

INTRODUCTION

The simplest test and the most effective way of checking a liquid cooling system for leaks is with a pressure tester. In this learning activity package you will learn how to pressure test a tractor cooling system.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Using the designated tractor, a pressure tester, and an adaptor, test the radiator cap for pressure tolerance. The gauge reading should be within one gradation of the instructor's reading.

2. Using the designated tractor and a pressure tester, test the cooling system for leaks. All cooling system leaks should be identified.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), p. 8-3, "Testing the Radiator," and 8-4, "Radiator Caps."

(or)_____

2 CHECK YOUR KNOWLEDGE of pressure testing the cooling system by taking Student Self-Check, PRESSURE TESTING THE COOLING SYSTEM.

3 READ the manufacturer's service manual for the pressure tester.

(or)_____

4 FIND AND RECORD the pressure cap specifications in the manufacturer's service manual for the designated tractor.

(or)_____

5 READ INSTRUCTIONS, PRESSURE TESTING THE COOLING SYSTEM.

(or)_____

6 PRACTICE setting up the pressure tester.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Pressure Tester and Adaptor
3. Test Radiator Cap
4. Manufacturer's Service Manual

MATERIALS AND SUPPLIES NEEDED

None

SAFETY

1. In testing cooling system, follow directions when building pressure.
2. Be careful in removing pressure radiator cap from tractor when engine is hot.

INSTRUCTIONS

PRESSURE TESTING THE COOLING SYSTEM

When pressure testing the cooling system, the following procedure should be used:

1. Carefully remove cap from radiator.

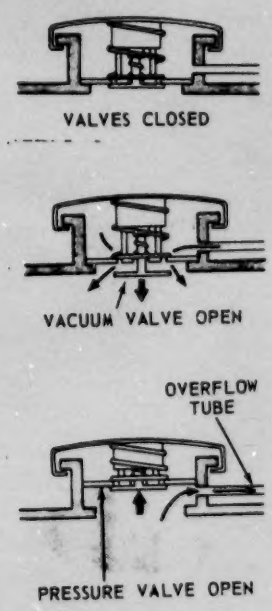


Figure 1. Pressure Control Radiator Cap

Courtesy of John Deere and Company

11

2. Install cap on pressure tester.

Figure 2. Testing The Radiator Cap

Courtesy of John Deere and Company

3. Pump up pressure tester until cap releases.

4. Record reading on the pressure tester.

5. Compare the reading on the pressure tester with cap specifications.

6. Replace cap if defective.

After determining that the cap to be used is functional, check the rest of the system at maximum cap pressure. The following procedure should be used:

1. Install pressure tester on filler neck.

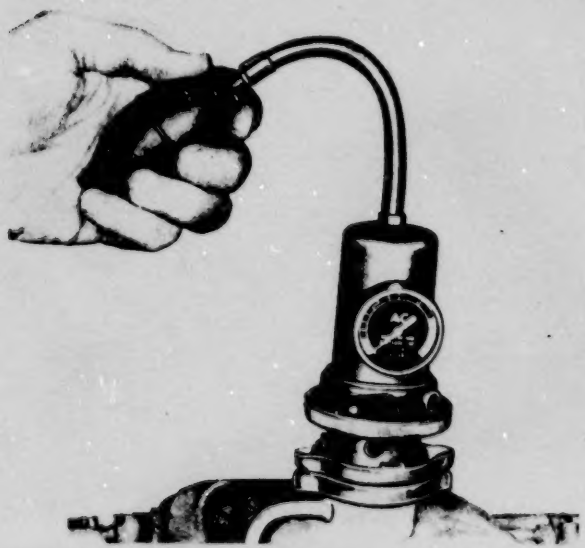


Figure 3. Radiator Pressure Test

Courtesy of John Deere and Company

2. Apply pressure to maximum operating pressure.

3. Inspect for visible leaks.

4. Correct all leaks or mark them for later repair. (NOTE: All repairs should be done only by experienced radiator repairer.)

5. Operate engine and observe pressure gauge. (Fluctuations indicate head gasket leakage.)

6. Remove pressure tester and reinstall radiator cap.

STUDENT SELF-CHECK

DO NOT WRITE ON THIS PAGE!

PRESSURE TESTING THE COOLING SYSTEM

Answer the following:

1. A minor leak in the radiator has been found. The student should remove the radiator and solder the hole before reinstalling. (True or False)

2. When visually inspecting the radiator, the tubes should be checked for:
   a.
   b.
   c.
   d.

3. What is the advantage of a pressure type cooling system?

4. Which of the following is not a function of the radiator cap?

   a. Helps prevent rusting of the radiator by keeping out oxygen.
   b. Prevents coolant escape at normal pressures.
   c. Allows atmosphere pressure to enter the cooling system.

5. Why should the radiator cap always be removed slowly and carefully?

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, TESTING THE COOLING SYSTEM PRESSURE.

On the designated tractor:

Test the radiator cap for correct pressure tolerance.

Test the cooling system for leaks.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CORRECT RESPONSES

1. False--Only experienced radiator repairer should attempt to repair radiators.
2. a. cracks
   b. kinks
   c. dents
   d. fractured seams
3. It permits operating the engine at a higher temperature without boiling the coolant or losing it by evaporation.
4. a
5. To avoid a possible fast discharge of hot coolant

13

DO NOT WRITE ON THIS PAGE

LAP TM–35

Student _____

Date _____

TESTING THE COOLING SYSTEM PRESSURE

Instructor's Final Checklist

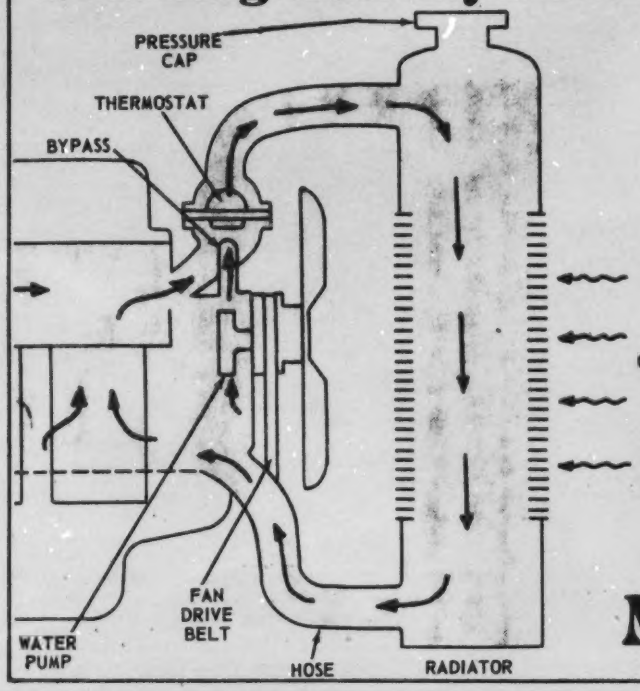
Check the student's performance in the following elements of testing the cooling system pressure.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
When pressure testing the radiator cap, the student:					
a.	carefully removed the radiator cap	[ ]	[ ]	[ ]	[ ]
b.	installed the cap on tester and pumped up pressure until the cap released	[ ]	[ ]	[ ]	[ ]
c.	recorded the reading	[ ]	[ ]	[ ]	[ ]
d.	compared the test reading with specifications	[ ]	[ ]	[ ]	[ ]
e.	determined if the cap was usable	[ ]	[ ]	[ ]	[ ]
When pressure testing the rest of the cooling system, the student:					
a.	installed the tester	[ ]	[ ]	[ ]	[ ]
b.	applied maximum operating pressure	[ ]	[ ]	[ ]	[ ]
c.	inspected for external leaks	[ ]	[ ]	[ ]	[ ]
d.	corrected or labeled all leaks	[ ]	[ ]	[ ]	[ ]
e.	operated the engine and observed the tester gauge for fluctuations	[ ]	[ ]	[ ]	[ ]
f.	removed the tester and reinstalled the radiator cap	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 36



Cleaning The Cooling System

Tractor Mechanics

Objective no. 42

Courtesy of John Deere and Company

INTRODUCTION

To carry away engine heat efficiently, the cooling system must be clean, both inside and out. Accumulated dirt and foreign matter are frequent causes of overheating. Since tractors often operate under dirty conditions, the cooling system needs regular cleaning. In this learning activity package you will learn how to clean a cooling system.

DIRECTIONS

Before you begin work on this learning activity package, be sure you have completed Learning Activity Package 34, TESTING COOLANT, and Learning Activity Package 35, TESTING THE COOLING SYSTEM PRESSURE.

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do this task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a water hose, appropriate tools, and a designated tractor, flush and clean the radiator system. The cleaned system should show no evidence of containing dirty coolant or foreign materials and should be free of leaks.

LEARNING ACTIVITIES

1 READ *Tractor Maintenance: Principles and Procedures* (AAVIM), pp. 119-128.

(or)_____

2 READ *Fundamentals of Machine Operation: Preventive Maintenance* (Deere & Company), p. 81.

(or)_____

3 READ INSTRUCTIONS, CLEANING THE COOLING SYSTEM.

(or)_____

4 CHECK YOUR KNOWLEDGE by taking Student Self-Check, CLEANING A COOLING SYSTEM.

5 READ the manufacturer's service manual for special instructions on flushing the system.

(or)_____

6 PRACTICE cleaning a cooling system on the designated tractor. Follow the procedure outlined in Learning Activity 3 and the manufacturer's service manual.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

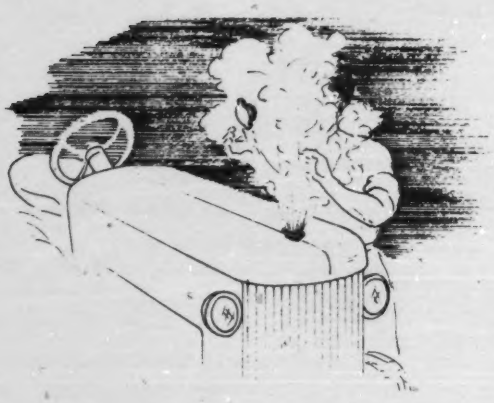


Figure 1. Quick removal of a radiator cap on a hot engine may cause you to get scalded.

Courtesy of the American Association for Vocational Instructional Materials

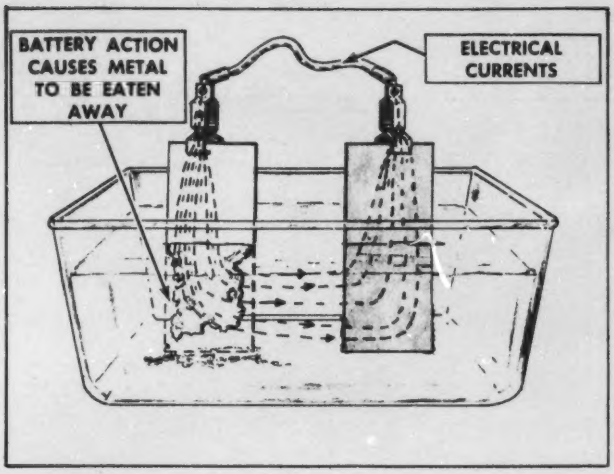


Figure 2. Electrical currents caused by the presence of two or more different metals such as stainless steel, brass, solder, aluminum and copper in the cooling system and in contact with the coolant, may set up a battery action that causes one of the metals to be eaten away.

Courtesy of the American Association for Vocational Instructional Materials

TOOLS AND EQUIPMENT NEEDED

Mechanic's Tool Set

MATERIALS AND SUPPLIES NEEDED

1. Water Hose
2. Gasket Sealer
3. Gasket
4. New Hoses
5. New Hose Clamps
6. Flushing or Cleaning Compound

SAFETY

1. Do Not Come In Contact With Hot Flushing Solution.
2. Wear Eye Protection.

INSTRUCTIONS

CLEANING THE COOLING SYSTEM

In cleaning the cooling system, the following procedure should be used:

1. Put on protective goggles.
2. Remove radiator cap. (CAUTION: Do NOT remove cap from a hot radiator.)
3. Drain the cooling system. Clean foreign materials from outside of radiator with compressed air and water or steam cleaner.
4. Disconnect lower radiator hose with screwdriver and hose-clamp pliers.
5. Remove thermostat from thermostat elbow.
6. Reinstall thermostat elbow.

Figure 4. For flushing a cooling system, (a) a commerical flushing compound is more effective than a washing-soda-and-water solution. (b) A cleaner is required to remove an accumulation of rust and scale deposits.

Courtesy of the American Association for Vocational Instructional Materials

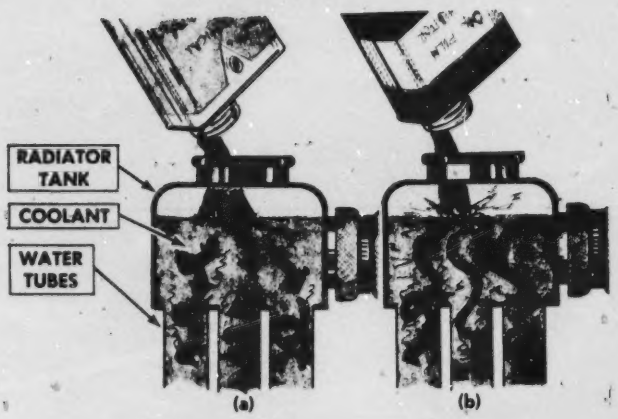


Figure 3. Rust inhibitors are of two general types: (a) chemical and (b) soluble oil (film) type.

Courtesy of the American Association for Vocational Instructional Materials

7. Run water through the cooling system until it runs clean. (Note: Flushing compound and back-flushing may be needed for extremely dirty systems.)
8. Reinstall thermostat and radiator hose with new gasket.
9. Refill cooling system with proper coolant solution and check for leaks.
10. Pressure-test cooling system.

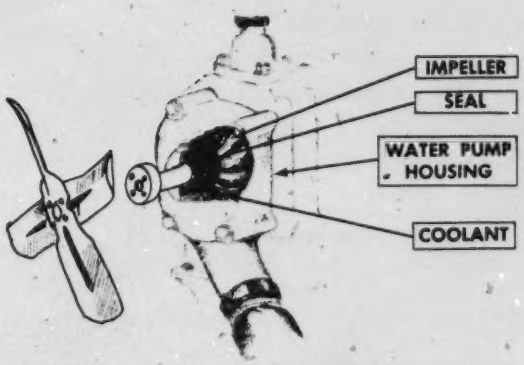


Figure 5. Cut-away View of a Water Pump.

Courtesy of the American Association for Vocational Instructional Materials

17

STUDENT SELF–CHECK
DO NOT WRITE ON THIS PAGE!
CLEANING THE COOLING SYSTEM

Answer the following:

1. Describe a simple test for a clogged radiator core.

2. To examine a cooling system for cleanliness scrape a finger around the inside of radiator neck for the accumulation of_____or_____ muck.

3. The appearance of_____in radiator indicates either the corrosion inhibitor has worn out or the system was _____with an inhibitor.

4. Why should the thermostat be removed when cleaning the system?

5. It is of little importance to clean insects and dirt from radiator air passages. (T or F)

6. Name the major parts of the cooling system.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, CLEANING THE COOLING SYSTEM.

Flush and clean the radiator on the designated tractor.

CORRECT RESPONSES

1. Clogged radiators will have cold spots immediately after engine operation.
2. Rust or Oily
3. Rusty Water, Not Treated
4. The thermostat would block the free flow of water in the cooling system.
5. False
6. Water jacket, radiator, water pump, fan, fan belt, thermostat, water hose.

18

DO NOT WRITE ON THIS PAGE

LAP TM–36

Student _____

Date _____

CLEANING THE COOLING SYSTEM

Instructor's Final Checklist

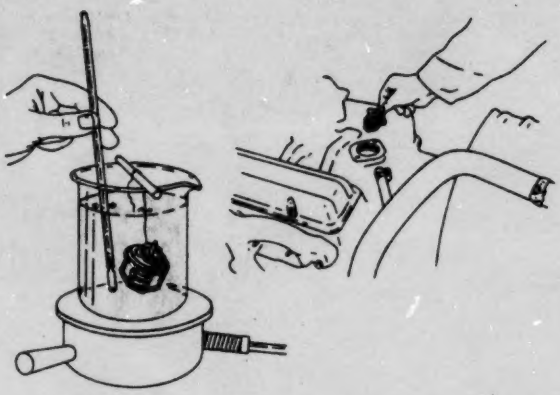
Check the student's performance in the following elements of cleaning the cooling system.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In cleaning the cooling system, the student:					
a.	put on protective goggles	[ ]	[ ]	[ ]	[ ]
b.	removed radiator cap	[ ]	[ ]	[ ]	[ ]
c.	drained cooling system	[ ]	[ ]	[ ]	[ ]
d.	disconnected the lower radiator hose	[ ]	[ ]	[ ]	[ ]
e.	removed the thermostat	[ ]	[ ]	[ ]	[ ]
f.	reinstalled the thermostat elbow	[ ]	[ ]	[ ]	[ ]
g.	ran clean water through the system until it ran clear	[ ]	[ ]	[ ]	[ ]
h.	used flushing compound, if necessary	[ ]	[ ]	[ ]	[ ]
i.	reinstalled the thermostat and lower hose	[ ]	[ ]	[ ]	[ ]
j.	refilled the cooling system with proper coolant solution	[ ]	[ ]	[ ]	[ ]
k.	pressure-tested the system	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 37



Courtesy of John Deere and Company

Servicing A Thermostat

Tractor Mechanics

Objective nos. 43,50

INTRODUCTION

The cooling system thermostat controls the tractor engine operating temperature. If the thermostat opens too quickly, the engine will run cold and be inefficient. If the thermostat opens too slowly, the engine will overheat, causing serious engine damage. A thermostat, to do its job, must be a sensitive device and being so, it is rather trouble-prone. When trouble is suspected, the thermostat should be tested for proper functioning. In this learning activity package you will learn how to remove, test, and reinstall or replace a thermostat.

DIRECTIONS

Before you begin work on this learning activity package, be sure you have completed Learning Activity Package 34, TESTING COOLANT, and Learning Activity Package 35, PRESSURE TESTING THE COOLING SYSTEM.

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVES

1. Using a thermometer, a container of antifreeze solution, a .003 inch (≈0.08 mm) feeler gauge, and the proper tools, test the thermostat on the designated tractor. The thermostat reading, when the valve opens, should agree with the instructor's reading within + or − 3 degrees F. (1.0 degree C.)

2. Given a new thermostat and gasket, the manufacturer's service manual, and the necessary tools, replace the cooling system thermostat on an engine. The new thermostat will be clean, installed according to directions in the manufacturer's service manual, and will function to specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 8-7 to 8-8.

(or)_____

2 READ INSTRUCTIONS, SERVICING A THERMOSTAT.

(or)_____

3 READ the section on thermostats in the manufacturer's service manual.

(or)_____

4 PRACTICE removing, testing, and reinstalling the thermostat on a lab engine or tractor.

5 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

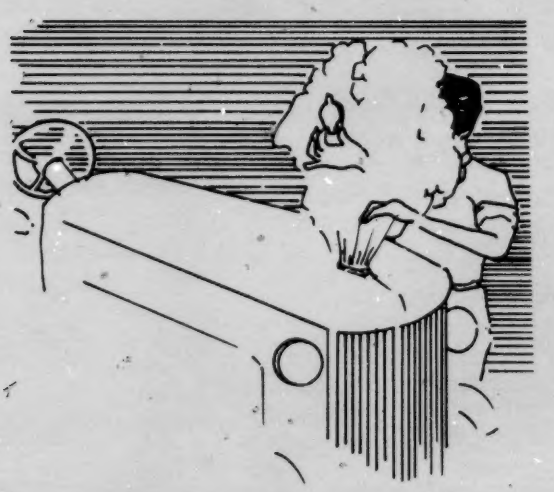


Figure 1. Quick removal of a radiator cap on a hot engine may cause you to get scalded.

Courtesy of the American Association for Vocational Instructional Materials

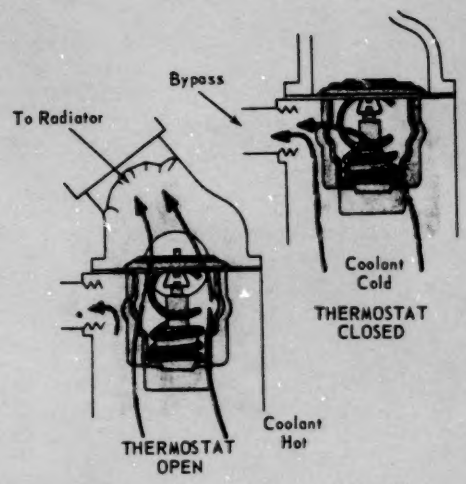


Figure 2. Cooling System Thermostat

Courtesy of John Deere and Company

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Thermometer
3. Feeler Gauge
4. Electric Hot Plate
5. Container of Water
6. Manufacturer's Service Manual

MATERIALS AND SUPPLIES NEEDED

Tractor Thermostat

SAFETY

Remove pressure radiator cap carefully when the radiator is hot.

INSTRUCTIONS

SERVICING A THERMOSTAT

A. When testing a thermostat, the following procedure should be used:

1. Remove thermostat. (See Section B below.)
2. Fill a clear pyrex container with antifreeze solution. (CAUTION: This procedure involves a beaker of extremely hot coolant solution.)
3. Insert a thermometer in the solution in such a manner that it does not touch the sides or bottom of the container.
4. Insert a .003 inch (.0762 mm) feeler gauge between the valve and seat of thermostat.
5. Suspend thermostat in the solution so that it does not touch the sides or bottom of the container.

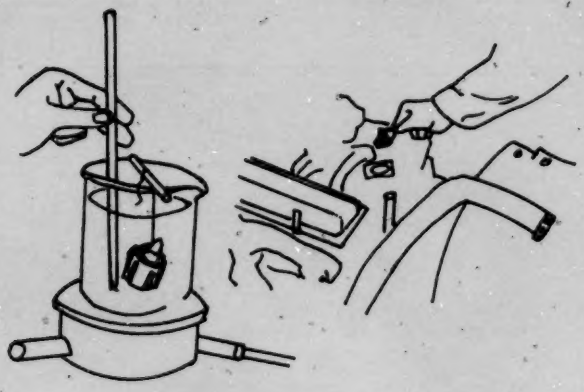


Figure 3. Testing A Thermostat

Courtesy of John Deere and Company

6. Heat solution. Stir to distribute heat evenly.
7. Record temperature when feeler gauge slips free of the valve. Compare with manufacturer's specifications.
8. Record temperature at which thermostat reached full open position. Compare with manufacturer's specifications.
9. Dry thermostat.
10. Reinstall thermostat if it tests out well, or replace it if it is defective.

B. There are two types of thermostats: (1) the bellows type and (2) the bimetallic type. Replace thermostat with the type recommended in the manufacturer's service manual. When replacing a thermostat, the following procedure should be used:

1. Clean area thoroughly.
2. Following the directions given in the manufacturer's service manual, remove the old thermostat.
3. Clean gasket surfaces and install a new gasket.
4. Install new thermostat in engine water jacket. Position thermostat with expansion element toward the engine, making certain the frame does not block the water flow.
5. With outlet casting and gasket properly located, tighten the retaining nuts evenly and securely.
6. Start engine and check for leaks.

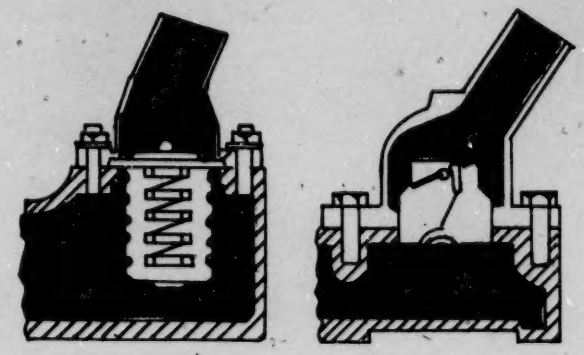


Figure 4. Types of Thermostats

Courtesy of John Deere and Company

22

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
CLEANING A COOLING SYSTEM

Answer the following:

1. What causes deposits in a cooling system? How can they be prevented?

2. Plain water is a satisfactory engine coolant in warm weather. (T or F)

3. "Permanent" anti-freeze never wears out. (T or F)

4. Why must the thermostat be removed when flushing the cooling system?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING THE THERMOSTAT.

On the designated tractor:

Test the thermostat.

Replace the cooling system thermostat.

CORRECT RESPONSES

1. Hard water; use soft water, avoid leaks, avoid overfilling
2. False
3. False
4. To allow clean water to flow through all the cooling system

DO NOT WRITE ON THIS PAGE

LAP TM–37

Student _____

Date _____

SERVICING THE THERMOSTAT

Instructor's Final Checklist

Check the student's performance in the following elements of servicing the thermostat.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In testing a thermostat, the student:				
	a. removed the thermostat	[ ]	[ ]	[ ]	[ ]
	b. prepared container of antifreeze with thermometer	[ ]	[ ]	[ ]	[ ]
	c. inserted .003" feeler gauge in thermostat	[ ]	[ ]	[ ]	[ ]
	d. suspended thermostat in solution	[ ]	[ ]	[ ]	[ ]
	e. heated and stirred solution	[ ]	[ ]	[ ]	[ ]
	f. recorded initial opening temperature and fully open temperature	[ ]	[ ]	[ ]	[ ]
	g. got a recorded reading within 3 degrees of the instructor's	[ ]	[ ]	[ ]	[ ]
	h. determined if thermostat should be re-used or replaced	[ ]	[ ]	[ ]	[ ]
	i. correctly reinstalled or replaced thermostat	[ ]	[ ]	[ ]	[ ]
2.	In replacing a thermostat, the student:				
	a. cleaned the area thoroughly	[ ]	[ ]	[ ]	[ ]
	b. removed old thermostat	[ ]	[ ]	[ ]	[ ]
	c. installed new thermostat, gasket, and housing	[ ]	[ ]	[ ]	[ ]
	d. checked for leaks	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 38

Replacing The Radiator Hose

Courtesy of John Deere and Company

Tractor Mechanics

Objective no.44

INTRODUCTION

The radiator hose carries coolant between the engine and the radiator. Radiator hoses, which are made of synthetic rubber, are reinforced with fabric and sometimes with wire. They are constantly being attacked by heat, pressure, oxidation, vibration, and cooling system chemicals. All cooling system hoses should be inspected regularly. At the first sign of damage or weakness in a hose, it should be replaced. The replacement hose will probably cost less than the coolant that would be lost if the hose burst in the field. In this learning activity package you will learn how to replace a radiator hose.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Learning Activity Package 34, TESTING COOLANT, and Learning Activity Package 35, PRESSURE TESTING THE COOLING SYSTEM.

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a screwdriver, hose-clamp pliers, and scraper, replace the radiator hose on the designated tractor. The new hose should show no visible signs of leaks.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 8-8 and 8-9.

(or)_____

2 READ INSTRUCTIONS, REPLACING THE RADIATOR HOSE, or I & T Shop Manual For Tractor Being Serviced.

(or)_____

3 INSPECT at least two different models of tractors to see what is involved in changing each radiator hose.

(or)_____

4 CHECK YOUR KNOWLEDGE of radiator hoses by taking Student Self-Check, REPLACING RADIATOR HOSES.

5 PRACTICE changing a radiator hose on a lab engine or mock-up.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

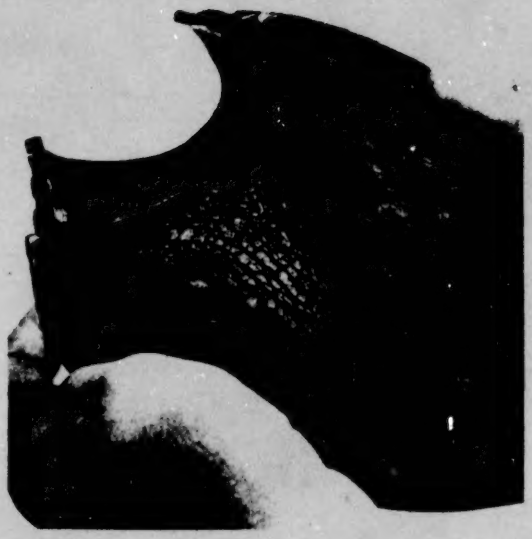


Figure 2. Interior Of Damaged Hose

Courtesy of John Deere and Company

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set
2. Pressure Tester and Adaptor
3. Antifreeze Tub or Bucket to Drain System

MATERIALS AND SUPPLIES NEEDED

New water hose and clamps if needed

SAFETY

Make sure radiator pressure is relieved before removing hoses.

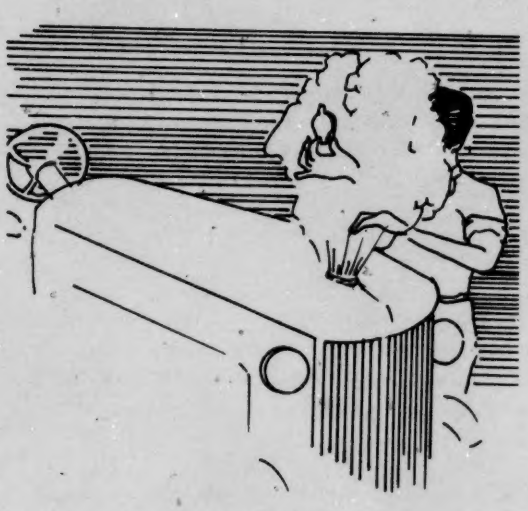


Figure 1. Quick removal of a radiator cap on a hot engine may cause you to get scalded.

Courtesy of the American Association for Vocational Instructional Materials

INSTRUCTIONS

REPLACING THE RADIATOR HOSE

In replacing a radiator hose (or any cooling system hose), the following procedure should be used:

1. Drain radiator system. (Note: If the coolant is to be re-used, it is necessary to drain the system only to a level below the hose being replaced.)
2. Remove old hose.
3. Clean radiator neck and engine inlet/outlet fixtures.
4. Apply sealing compound.
5. Install new radiator hose (with new clamps, if needed).
6. Refill with coolant and check for leaks.
7. Tighten any loose connections.
8. Pressure test system. (See Module TM-35.)

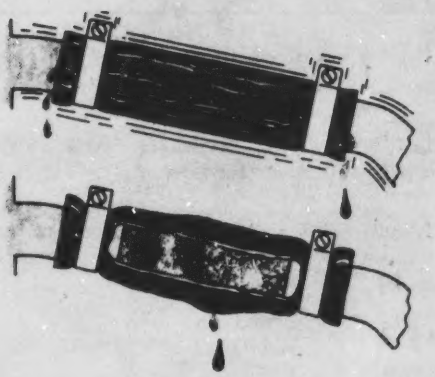


Figure 4. Damaged Hoses

Courtesy of John Deere and Company

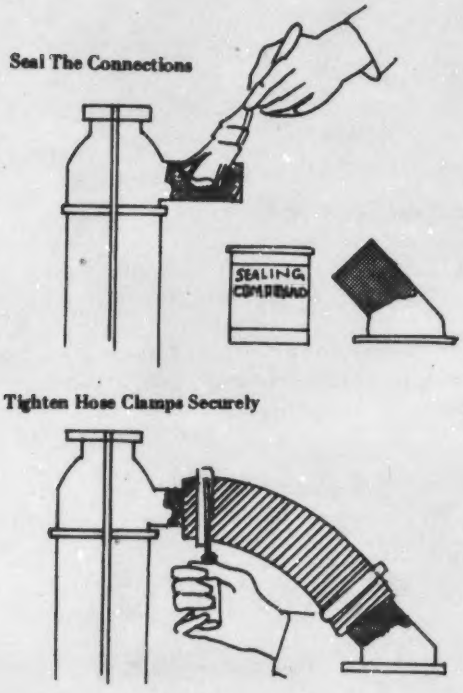


Figure 3. Connecting Hoses

Courtesy of John Deere and Company

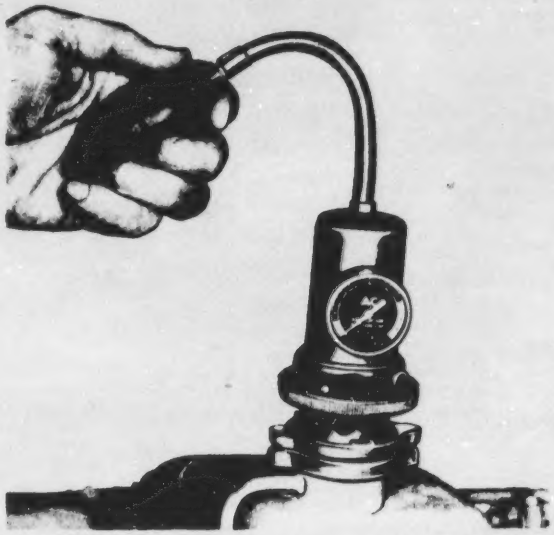


Figure 5. Testing The Cooling System Pressure

Courtesy of John Deere and Company

STUDENT SELF–CHECK
DO NOT WRITE ON THIS PAGE!
REPLACING RADIATOR HOSES

Answer the following:

1. In what ways do radiator hoses show damage?

2. How often should hoses be examined?

3. Deterioration of hose usually takes place from the outside more than inside. (T or F)

4. Hardening of old hose causes little or no trouble with relation to leaking. (T or F)

5. Excessive heat and water cause limited service life of water hose. (T or F)

6. Engine vibration will not loosen hose connections or cause abnormal wear. (T or F)

7. In what way will hose failures cause clogged radiator?

8. Leaks are more common at_____ connections than anywhere else in the cooling system.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPLACING RADIATOR HOSE.

Replace radiator hose on the designated tractor.

CORRECT RESPONSES

1. Hardening, cracking, swelling, and softening
2. At least twice a year.
3. False
4. False
5. True
6. False
7. Rubber particles from rotted hose linings will clog radiator water tubes.
8. Radiator hose

DO NOT WRITE ON THIS PAGE

LAP TM–38

Student _____

Date _____

REPLACING RADIATOR HOSE

Instructor's Final Checklist

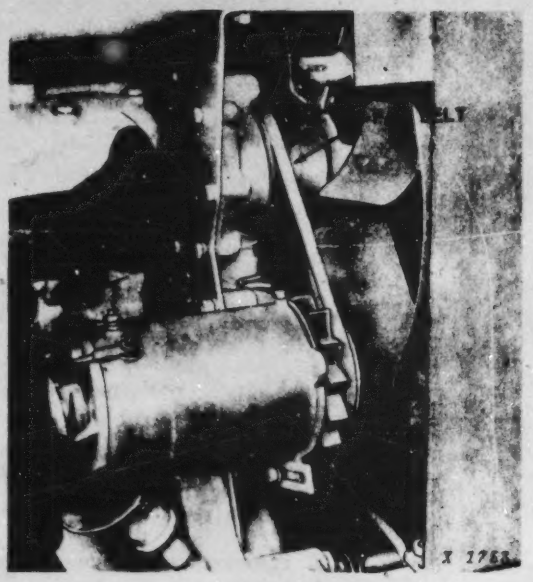
Check the student's performance in the following elements of replacing radiator hose.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In replacing the radiator hose, the student:				
a. drained the coolant	[ ]	[ ]	[ ]	[ ]
b. removed the old hose	[ ]	[ ]	[ ]	[ ]
c. cleaned the connections	[ ]	[ ]	[ ]	[ ]
d. applied sealing compound	[ ]	[ ]	[ ]	[ ]
e. installed a new hose	[ ]	[ ]	[ ]	[ ]
f. used new clamps, if needed	[ ]	[ ]	[ ]	[ ]
g. refilled with coolant	[ ]	[ ]	[ ]	[ ]
h. checked for leaks	[ ]	[ ]	[ ]	[ ]
i. corrected any leaks	[ ]	[ ]	[ ]	[ ]
j. pressure-tested the system	[ ]	[ ]	[ ]	[ ]
2. The newly installed hose showed no leaks or bulges	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 39



Courtesy of John Deere and Company

Replacing A Fan Belt

Tractor Mechanics

Objective no.46

INTRODUCTION

The fan belt drives the radiator cooling fan. The fan is almost always mounted on the water pump, which is driven by the same belt and circulates the coolant. The fan belt also drives the generator or alternator on most tractors. The belt tension should be checked regularly and adjusted when necessary. The fan belt should be replaced when it shows signs of damage or excessive wear. In this learning activity package you will learn how to replace and adjust a fan belt.

DIRECTIONS

Read the objectives below. If you believe you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or

If you need to complete learning activities in order to be able to do the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a new fan belt, manufacturer's service manual, open-end wrenches, and belt-tension gauge, replace the belt on the designated tractor and adjust tension to manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Tractor Maintenance: Principles and Procedures* (AAVIM), pp. 15-17.

(or)_____

2 READ INSTRUCTIONS, REPLACING A FAN BELT.

(or)_____

3 CHECK YOUR KNOWLEDGE by completing Student Self-Check, REPLACING A FAN BELT.

(or)_____

4 RECORD fan belt specifications from the manufacturer's service manual.

(or)_____

5 PRACTICE replacing and tightening a fan belt on the shop tractor.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's Tool Set (necessary box & open-end wrenches, large screw driver or suitable pry bar for adjusting belt tension)
2. Manufacturer's Service Manual or I & T Shop Manual
3. Belt-Tension Gauge

MATERIALS AND SUPPLIES NEEDED

Fan Belt

SAFETY .

1. Never attempt to adjust belt when engine is running or being cranked.
2. Make sure all tools are removed from fan area before cranking engine.
3. When fan is removed to replace belt, double check you fan belts.
4. Make sure the ignition switch is turned off on spark-ignition engine. You may move crankshaft enough to cause one cylinder to fire and start the engine resulting in serious injury.

INSTRUCTIONS

REPLACING A FAN BELT

In replacing a fan belt, the following procedure should be used:

1. Loosen tension on fan belt.
2. Remove old belt.
3. Install new fan belt.
4. Check for correct alignment.
5. Adjust tension to manufacturer's specifications. (See illustration below.)

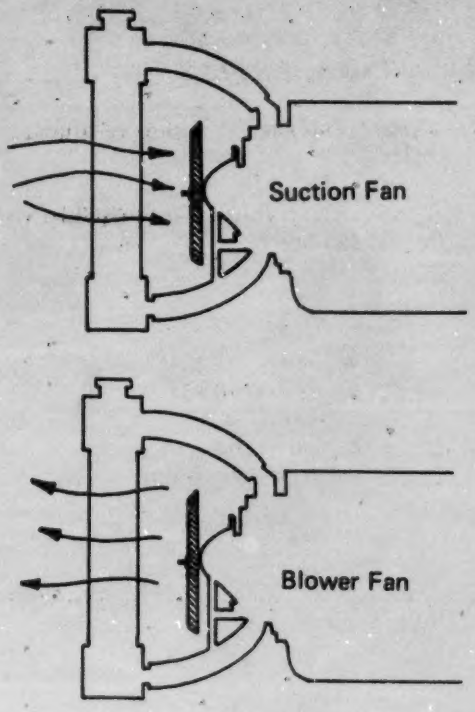


Figure 1. Two types of cooling system fans

Courtesy of John Deere and Company

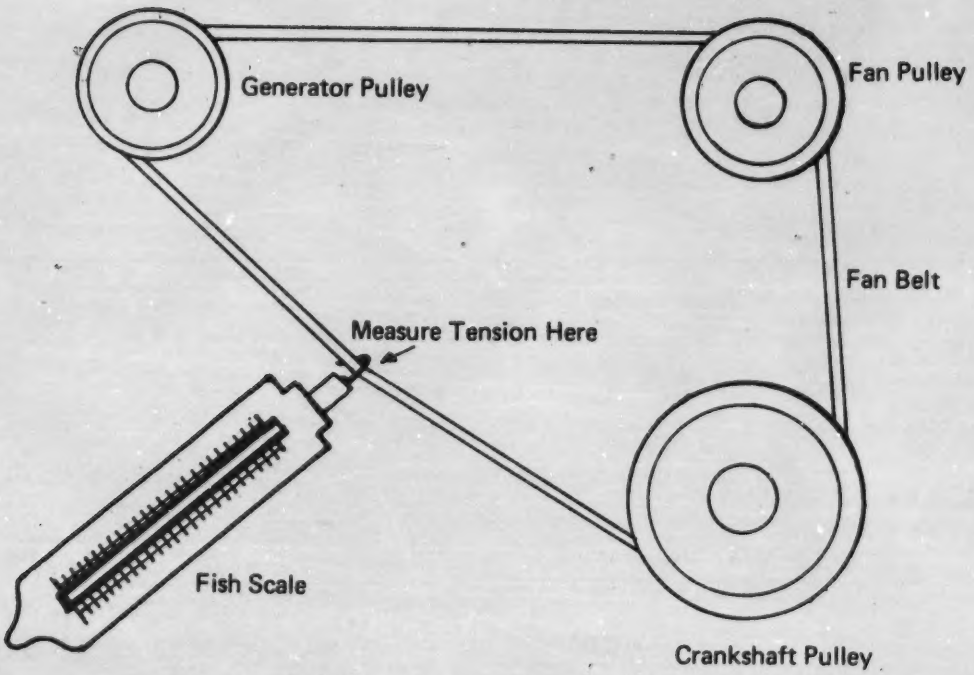


Figure 2. Adjusting The Fan Belt

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
REPLACING A FAN BELT

1. Briefly explain the function of the fan belt.

2. Which of the following might be driven by the fan belt?

   a. fan
   b. water pump
   c. crankshaft
   d. generator
   e. hydraulic pump

3. The tighter the fan belt, the better. (True or False)

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPLACING A FAN BELT.

Replace the fan belt on the designated tractor.

CORRECT RESPONSES

1. The fan belt serves to operate the water pump, fan, generator and hydraulic pump.
2. all but c
3. False. A fanbelt should be tightened to manufacturer's specifications.

DO NOT WRITE ON THIS PAGE

LAP TM–39

Student _____

Date _____

REPLACING A FAN BELT

Instructor's Final Checklist

Check the student's performance in the following elements of replacing a fan belt.

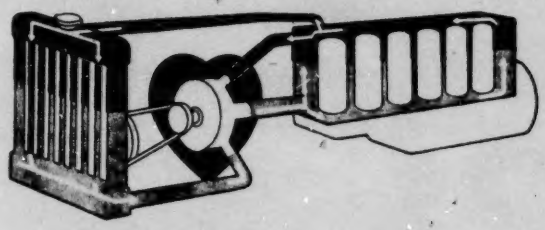
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In replacing a fan belt, the student:				
a. released belt tension	[ ]	[ ]	[ ]	[ ]
b. removed old belt	[ ]	[ ]	[ ]	[ ]
c. installed new belt	[ ]	[ ]	[ ]	[ ]
d. checked alignment	[ ]	[ ]	[ ]	[ ]
e. adjusted tension	[ ]	[ ]	[ ]	[ ]
f. securely tightened all bolts	[ ]	[ ]	[ ]	[ ]
2. The belt tension was to manufacturer's specifications when rechecked by the instructor	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 40

REPLACING THE WATER PUMP



Courtesy of John Deere and Company

Tractor Mechanics

Objective no. 45

INTRODUCTION

The water pump is the heart of the cooling system. It carries the radiator fan and circulates the coolant through the engine and radiator. When a water pump becomes defective, it is usually replaced rather than repaired. In this learning activity package you will learn how to replace a water pump.

DIRECTIONS

Before you begin this module, be sure you have completed Learning Activity Package 34, TESTING COOLANT, and Learning Activity Package 35, TESTING COOLING SYSTEM PRESSURE.

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or

If you need to complete learning activities in order to be able to perform the task, turn to page 2 and go through the Learning Activities in the order given.

OBJECTIVE

Given a socket set, open-end and box-end wrench set, screwdrivers, clamp pliers, and gasket-sealing compound, replace water pump. The replaced water pump should show no signs of leakage, and all steps in the installation process should be completed according to the manufacturer's service manual.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Engines* (Deere & Company), pp. 8-5 and 8-6.

(or)_____

2 READ INSTRUCTIONS, REPLACING A WATER PUMP.

(or)_____

3 CHECK YOUR KNOWLEDGE of water pumps by completing Student Self-Check, UNDERSTANDING WATER PUMPS.

4 READ the manufacturer's service manual for the recommended procedure for installing the water pump or I & T Shop Manual For Given Tractor.

(or)_____

5 PRACTICE installing a water pump.

6 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITY on page 4.

TOOLS AND EQUIPMENT NEEDED

1. Mechanic's tool set
2. Hose clamp pliers
3. I & T Shop Manual for Tractor
4. Manufacturer's Service Manual For Tractor

MATERIALS AND SUPPLIES NEEDED

1. Water pump
2. Water pump gasket
3. Gasket sealing compound
4. New water hose and clamps if needed
5. Necessary supplies for cleaning area where new pump is to be located

SAFETY

Make sure the water system has cooled before removal.

INSTRUCTIONS

REPLACING A WATER PUMP

In replacing a water pump, the following procedure should be used:

1. Drain cooling system.
2. Remove necessary equipment to reach water pump.
3. Disconnect hoses from water pump.
4. Remove water pump from engine.
5. Clean area where new pump is to be located.
6. Coat gasket with sealing compound.
7. Install gasket on engine.
8. Install replacement pump on gasket.
9. Torque to specifications.
10. Reconnect hoses.
11. Replace other equipment and adjust drive belts.
12. Fill with coolant and check for leakage.
13. Pressure-test the cooling system.

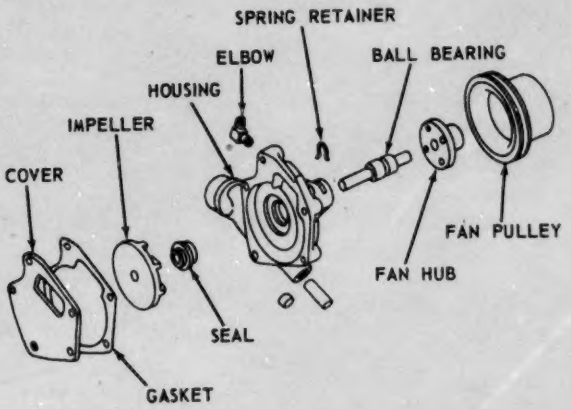


Figure 1. Water Pump Disassembled

Courtesy of John Deere and Company

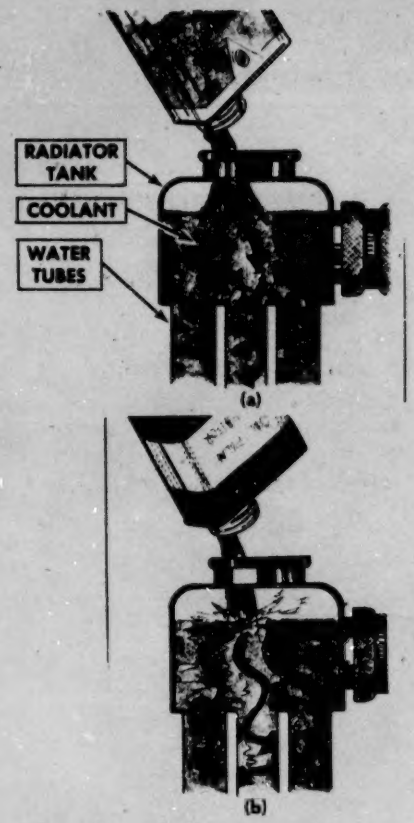


Figure 2. Rust inhibitors are of two general types: (a) chemical and (b) soluble oil (film) type.

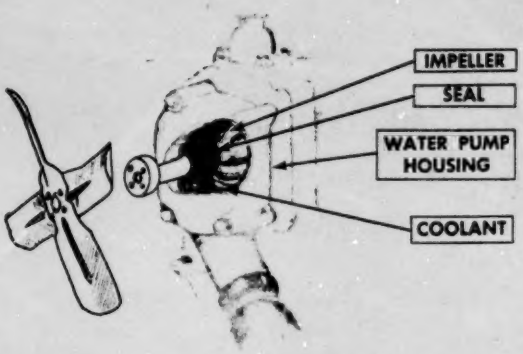


Figure 3. Cut-away View of a Water Pump

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF-CHECK
DO NOT WRITE ON THIS PAGE!
UNDERSTANDING WATER PUMPS

Answer the following:

1. What is the most common type of water pump?

2. What is the likely result of water pump failure?

3. How are most water pumps driven?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next Learning Activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, REPLACING A WATER PUMP.

Replace the water pump on the designated tractor.

CORRECT RESPONSES

1. Centrifugal
2. Engine overheating
3. By the fan belt

38

DO NOT WRITE ON THIS PAGE

LAP TM–40

Student _____

Date _____

REPLACING A WATER PUMP

Instructor's Final Checklist

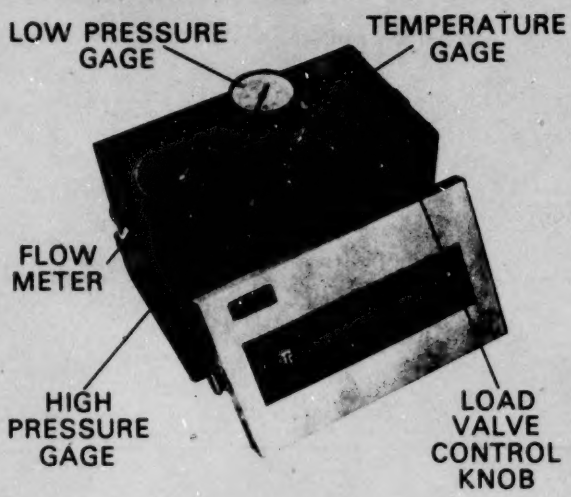
Check the student's performance in the following elements of replacing a water pump.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In replacing a water pump, the student:				
	a. drained cooling system	[ ]	[ ]	[ ]	[ ]
	b. removed water pump	[ ]	[ ]	[ ]	[ ]
	c. coated and installed gasket	[ ]	[ ]	[ ]	[ ]
	d. installed pump according to the manufacturer's procedure	[ ]	[ ]	[ ]	[ ]
	e. torqued bolts	[ ]	[ ]	[ ]	[ ]
	f. filled cooling system and tightened belts	[ ]	[ ]	[ ]	[ ]
	g. pressure-tested cooling system for leaks	[ ]	[ ]	[ ]	[ ]
2.	The replaced water pump did not leak	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 41



Courtesy of John Deere and Company

Testing the Hydraulic System

Tractor Mechanics

Objective no.147

INTRODUCTION

A basic hydraulic system is made up of an oil reservoir, a pump, a control valve, a cylinder, check valves, relief valves, and connecting hoses. Any one of these parts can break down, causing a malfunction in the entire system. This may cost expensive operating time. An accurate, efficient way of locating the trouble in a short period of time is by using a hydraulic tester. In this learning activity package you will learn how to test a hydraulic system using a hydraulic tester.

DIRECTIONS

Read the objective below. If you believe you are already able to perform this task, read the Check-Out Activity on page 7 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, find the Learning Activities inside this package and go through them in the order in which they are listed.

OBJECTIVE

Given the manufacturer's service manual for the designated tractor, a hydraulic tester, the instruction manual for the hydraulic tester and the needed tools, measure the oil flow, pressure, and temperature on the hydraulic system of the designated tractor. The results of the test should be within 5% of the results obtained by the instructor, and all precautions will be taken not to damage any parts.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 12, pp. 5, 6, and 8.

(or)_____

2 STUDY the manufacturer's instruction manual for the hydraulic tester. Become thoroughly familiar with how it must be used.

(or)_____

3 CHECK YOUR KNOWLEDGE by taking Student Self-Check I, ATTACHING THE HYDRAULIC TESTER.

4 CONSULT the manufacturer's service manual for the designated tractor to determine the type of system and the system specifications for relief valve pressure, pump output, operating temperature, and engine RPM.

(or) The T & I Shop Manual

5 READ Instructions. TESTING THE HYDRAULIC SYSTEM.

(or)_____

6 PRACTICE testing the hydraulic system of a designated tractor. Follow the procedure outlined in Learning Activity 5 and record the results on Instructions, RECORDING HYDRAULIC TEST RESULTS.

7 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activities on page 7.

TOOLS AND EQUIPMENT NEEDED

A hydraulic tester (analyzer or test gauge)

Mechanics tool kit

MATERIALS AND SUPPLIES NEEDED

Hydraulic oil

SAFETY

Hydraulic lines carry fluid (as much as 2,000 psi) under extremely high pressure. Mechanics have been seriously injured by hot fluid from an uncoupled or broken or loose hydraulic line.

INSTRUCTIONS

A TESTING THE HYDRAULIC SYSTEM

A hydraulic tester (analyzer or test gauge) will measure the oil flow, the pressure, and the temperature of the hydraulic system. It will also isolate the faulty components of the system. In testing the hydraulic system, the following procedure should be used:

1. Plug all openings of hydraulic system and steam clean the designated tractor. CAUTION: Dirt is the worst enemy of a hydraulic system. Keep all dirt out of the system.
2. Relieve any pressure in the system according to the manufacturer's instructions.
3. Disconnect the oil lines used to test the pump and connect them to the hydraulic test inlet and outlet.
4. Open the load valve of the hydraulic tester and start the engine.
5. Adjust the engine to the manufacturer's recommended operating speed.
6. Close the load valve until normal operating temperature is reached and then re-open the valve.
7. Record the pump flow at no pressure. Use Table I for recording results.
8. Close the load valve slowly until pressure increases. CAUTION: Never overload system beyond its maximum rated pressure.
9. Record the pump flow readings in increments of 250 PSI until the maximum rated pressure is reached.
10. Open the hydraulic tester load valve until the maximum pump flow is again at no pressure. Then shut off the engine.
11. Compare the recorded readings with the manufacturer's specifications to determine if the pump is operating satisfactorily.
12. If the pump is operating satisfactorily, run a systems test of each circuit according to the manufacturer's instructions.

NOTE: If each circuit's flow at each pressure level is the same as for the pump, then all components are all right. If not, and the (a) pressure drops prior to the time full load is reached, that particular circuit is bad; or (b) if flow drops by the same amount on all circuits, the relief valve may be the cause of the trouble. Check the manufacturer's service manual.

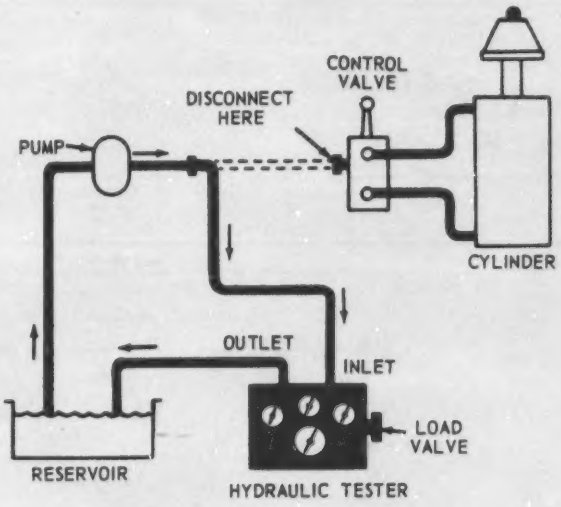


Figure 1. Testing the hydraulic pump.

Courtesy of John Deere and Company

TABLE I – HYDRAULIC TEST RESULTS

DO NOT WRITE ON THIS PAGE!

Tractor Model_____ Owner_____

Serial Number_____ Comments_____

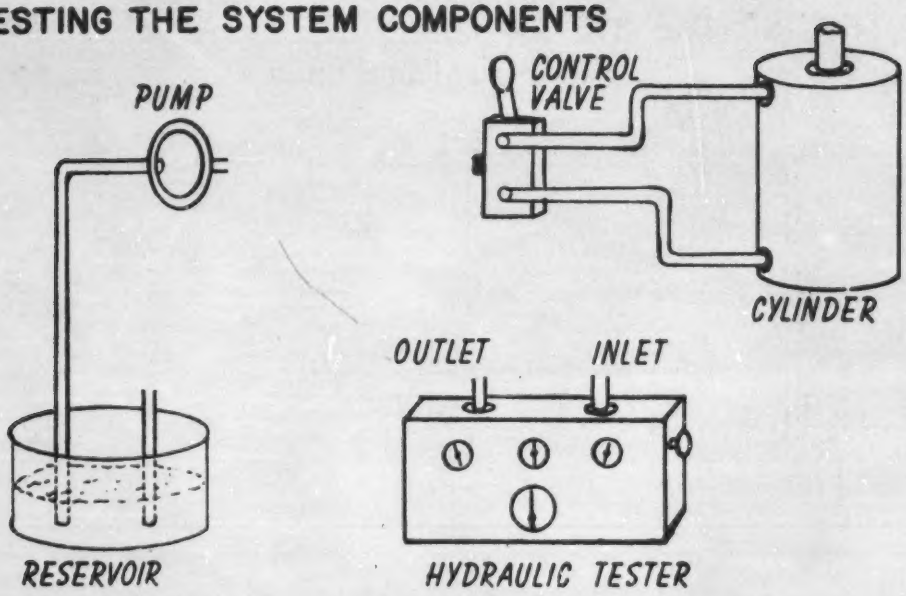
Equipment Used_____

		GALLONS PER MINUTE @ PSI							
		0	250	500	750	1000	1250	1500	1750
Pump Test									
Circuit Test	Direction Cylinder Travel								

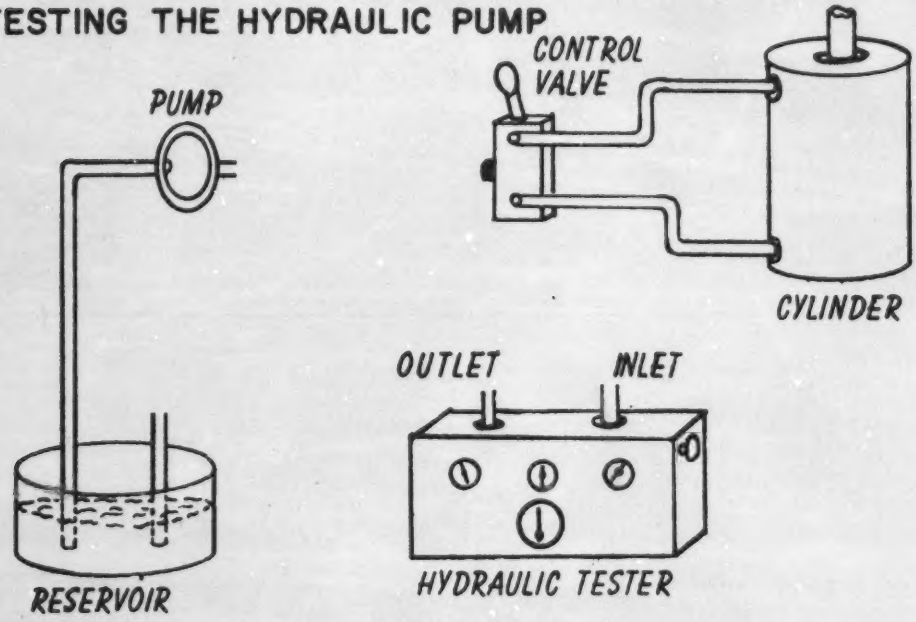
STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
ATTACHING THE HYDRAULIC TESTER

1. Draw in the lines from the inlet and the outlet of the hydraulic tester to the correct lines in the system for proper testing.

TESTING THE SYSTEM COMPONENTS



TESTING THE HYDRAULIC PUMP

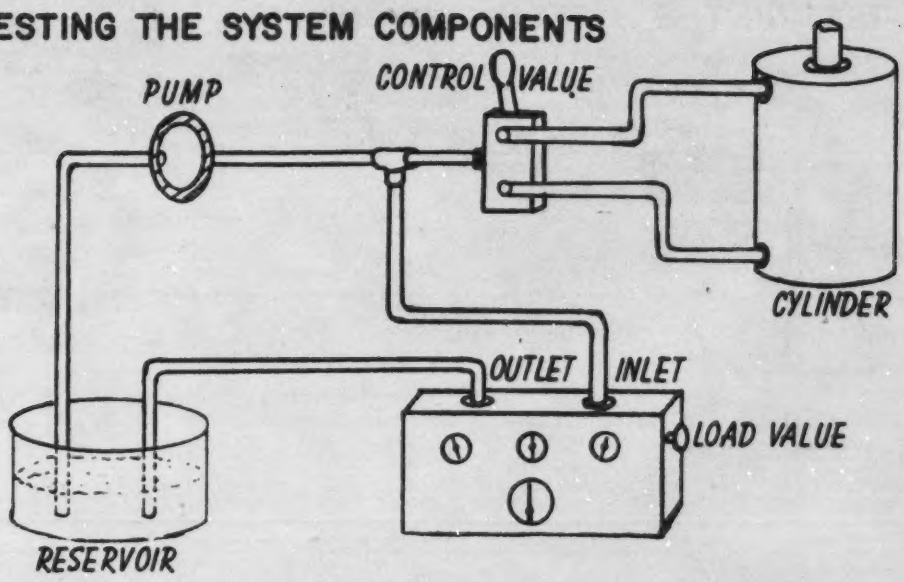


(Continued on the next page.)

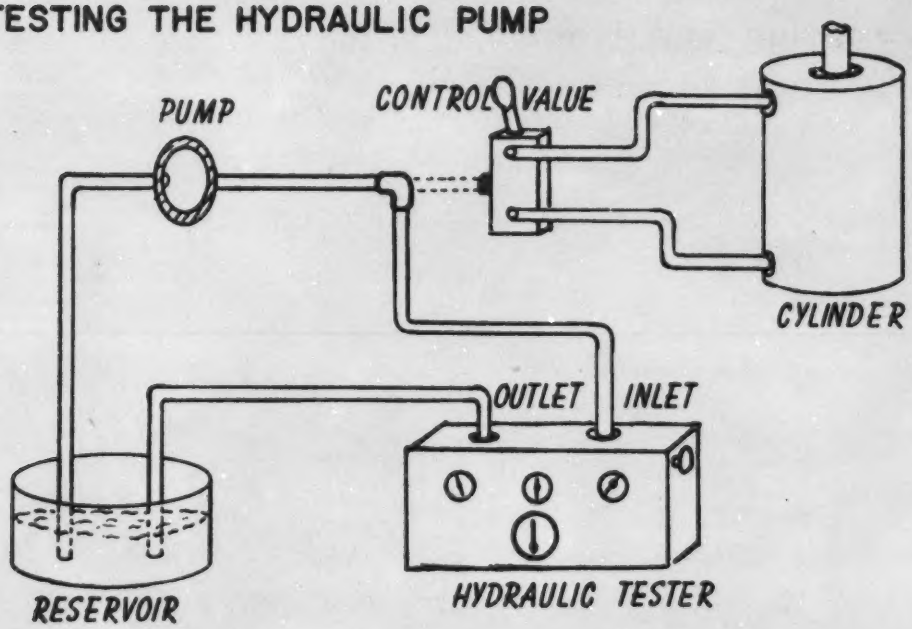
STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!

Compare your drawing with the correct diagram below. Make sure you understand how to attach a hydraulic tester before going on to the next learning activity.

TESTING THE SYSTEM COMPONENTS



TESTING THE HYDRAULIC PUMP



STUDENT SELF CHECK (Cont'd)
DO NOT WRITE ON THIS PAGE!

Answer the following questions. Then compare your answers with those at the bottom of the page.

2. Test the hydraulic system flow first so that you have a guide for reading on the pump flow test. (True or False)

3. What is the worst enemy of the hydraulic system? _____

4. How do you know if a hydraulic circuit is good? _____
_____

5. If the flow drops the same on all circuits, what would you expect the trouble to be? _____
_____

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, TESTING THE HYDRAULIC SYSTEM.

Measure the oil flow, pressure, and temperature of the hydraulic system on the designated tractor.

CORRECT RESPONSES

2. False. Test the pump first. It is the generating force for the whole system and affects the operation of all other system components.
3. Dirt
4. If the circuit's flow is the same as for the pump.
5. The relief valve may be malfunctioning.

DO NOT WRITE ON THIS PAGE

LAP TM–41

Student _____

Date _____

TESTING THE HYDRAULIC SYSTEM

Instructor's Final Checklist

Check the student's performance in the following elements of testing the hydraulic system.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

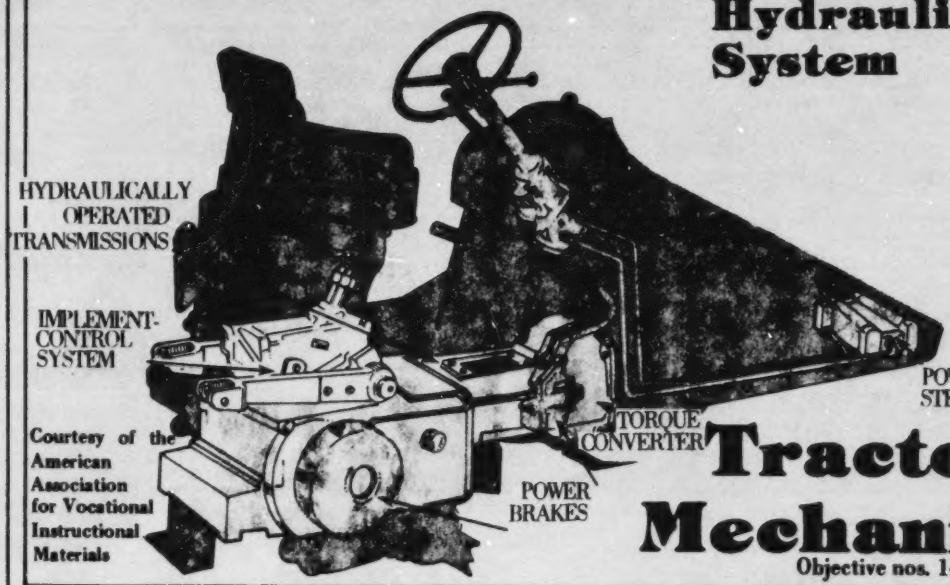
Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

In testing the hydraulic system, the student:

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	Prepared the tractor for testing by plugging all openings and steam cleaning the tractor hydraulic system	[ ]	[ ]	[ ]	[ ]
2.	Relieved any pressure in the system	[ ]	[ ]	[ ]	[ ]
3.	Obtained recorded readings on the hydraulic tester which were the same as the instructor's	[ ]	[ ]	[ ]	[ ]
4.	Obtained the same analysis on the hydraulic pump test as the instructor	[ ]	[ ]	[ ]	[ ]
5.	Obtained the same results as the instructor for the test of each system circuit	[ ]	[ ]	[ ]	[ ]
6.	Obtained the same diagnosis on the entire hydraulic system as the instructor	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 42

Maintaining Fluid in the Hydraulic System



Courtesy of the American Association for Vocational Instructional Materials

Tractor Mechanics

Objective nos. 143,144,145

INTRODUCTION

A hydraulic system is much more sensitive to contaminants in the oil than the crankcase lubricating system of a tractor. The check valves, relief valves, or control valves of a hydraulic system may become coated with contaminants, causing a malfunction of the system. A grain of sand in a control orifice (a tiny drilled hole in a circuit to limit the flow or create a pressure difference) may close down the system completely. This makes periodic cleaning of the entire hydraulic system a must. In this learning activity package you will learn how to drain, clean, flush, fill, and change the filter of a hydraulic system.

DIRECTIONS

Before you start this learning activity package, be sure you have completed Learning Activity Package 41, "Testing the Hydraulic System."

If you have completed this Learning Activity Package, read the objectives below. If you feel you are already able to perform these tasks, read the Check-Out Activities on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, find the Learning Activities inside this package and go through them in the order in which they are listed.

OBJECTIVES

(1) Given the manufacturer's service manual, the correct type of hydraulic oil and the tools needed, drain, clean and flush a hydraulic system. There should be no damage to the system, flushing should continue until the system is clean and the recommended oil must be used.

(2) Given the manufacturer's service manual, new hydraulic oil and the necessary tools, refill the hydraulic system in a clean area. The oil added must be that recommended by the manufacturer and at the correct level. The system should operate smoothly as determined by the instructor.

(3) Given the new filters recommended in the manufacturer's service manual, new parts and clean oil (if needed), and the necessary tools, change the hydraulic oil filters. The new filters must be the type recommended by the service manual. They should be installed correctly and function as specified. The relief valve should be clean and operative and the oil should be replaced if indicated.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 11, pp. 1 through 10.

(or) _____

2 CHECK YOUR KNOWLEDGE by taking Student Self-Check I, MAINTAINING FLUID IN THE HYDRAULIC SYSTEM.

3 READ the manufacturer's service manual to determine procedures, location of parts, and specifications for the hydraulic system on the designated tractor.

(or) The T & I Shop Manual

4 MAKE NOTES on the information obtained from the manufacturer's service manual.

(or) _____

5 READ Instructions, MAINTAINING FLUID IN THE HYDRAULIC SYSTEM.

(or) _____

6 LOCATE the drain plug, the filler plug, and filters on the designated tractor.

(or) _____

7 OBSERVE another student as he or she satisfactorily services the hydraulic system.

(or) _____

8 PRACTICE servicing the hydraulic system.

9 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activities listed on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS OR SUPPLIES

Recommended hydraulic fluid
Recommended solvent for flushing hydraulic system
Recommended hydraulic fluid filters
Cleaning rags

SAFETY

Make sure all hydraulic lifts or cylinders and controlling equipment are safely lowered and pressure relieved before servicing the system.

INSTRUCTIONS

MAINTAINING FLUID IN THE HYDRAULIC SYSTEM

In order to maintain fluid in the hydraulic system, the following procedure should be used:

1. Relieve all hydraulic pressure in system and discharge accumulator if needed.
2. Following the manufacturer's service manual recommendations, drain the system taking all necessary precautions.
3. Clean sediment from the reservoir.
4. Remove oil filters following procedure in manufacturer's service manual.
5. Clean the filter elements, or replace (if needed).
6. Flush out the oil remaining in the system with the hydraulic fluid recommended by the manufacturer. (CAUTION: Most chemical cleaners and solvents are not recommended for flushing hydraulic systems.)
7. Introduce specified amounts of flushing oil, and operate the equipment to cycle the flushing oil through the system.
8. Run oil through system until satisfactorily cleaned (from 4-48 hours).
9. Drain out flushing oil.
10. If working parts are sticking, they will need to be removed and cleaned individually.
11. Use a gum solvent or other non-corrosive chemical cleaner on metal parts.
12. Reinstall well cleaned filters, or install the new filters recommended by manufacturer, following the service manual instructions.
13. Clean the area around the filler cap.
14. Check the service manual for specified level of recommended hydraulic oil, and fill with oil to recommended level using only clean oil, funnels, and containers. (CAUTION: Make sure no dirt enters system.)
15. Replace filler cap.
16. Start the engine and warm the system before running the equipment through a working cycle four or five times to bleed air from the system.
17. Add oil (if needed) and run the machine until it functions smoothly at full capacity.
18. Stop engine and check oil level, adding new oil (if necessary) to reach recommended level.

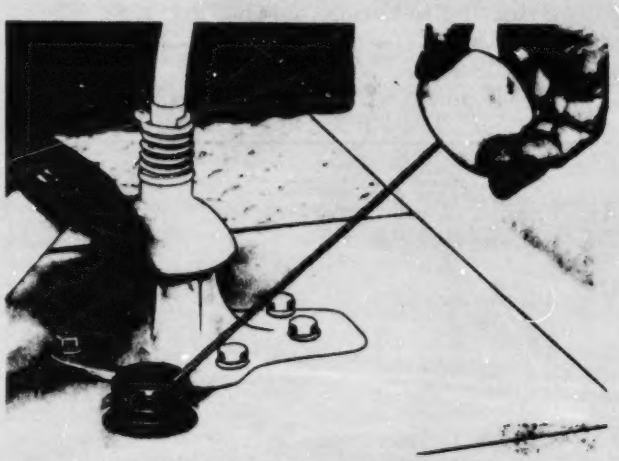


Figure 1. Check fluid level after servicing hydraulic-steering system. Add fluid as necessary.

Courtesy of John Deere and Company

STUDENT SELF CHECK

DO NOT WRITE ON THIS PAGE!

MAINTAINING FLUID IN THE HYDRAULIC SYSTEM

Answer the following:

1. What are the four maintenance problems repairers discover most often when answering a customer's complaint?

   a.
   b.
   c.
   d.

2. To flush the hydraulic system, use a non-petroleum solvent or a chemical cleaner. (True or False)

3. Thermal expansion is caused by oil expanding as a result of _____.

4. Match the following oil conditions with their causes:

a.	Foaming oil	1.	Heat
b.	Scorched oil	2.	Water
c.	Milky oil	3.	Air

5. Why is it so important to keep the working area clean?

6. Additives in hydraulic oil help to_____.

7. Which of the following is <u>not</u> a way to prevent air from entering the system?

   a. Keep reservoir at correct level
   b. Replace leaky suction lines
   c. Tighten leaky connections
   d. Keep your work area clean
   e. Bleeding system after repair

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, MAINTAINING FLUID IN THE HYDRAULIC SYSTEM.

On the designated tractor:

Drain a hydraulic system.

Flush the hydraulic system.

Change the hydraulic filters and refill the hydraulic system.

CORRECT RESPONSES

1. Not enough oil in the reservoir, clogged or dirty oil filters, loose intake lines, and incorrect oil in the system.
2. False – use a hydraulic oil as a flushing agent
3. Heat
4. a.–3, b.–1, c.–2
5. To keep the hydraulic system free of sludge, sediment, and gum or lacquer formations.
6. Keep contaminants from damaging or plugging the system.
7. d

DO NOT WRITE ON THIS PAGE

LAP TM–42

Student _____

Date _____

MAINTAINING FLUID IN THE HYDRAULIC SYSTEM

Instructor's Final Checklist

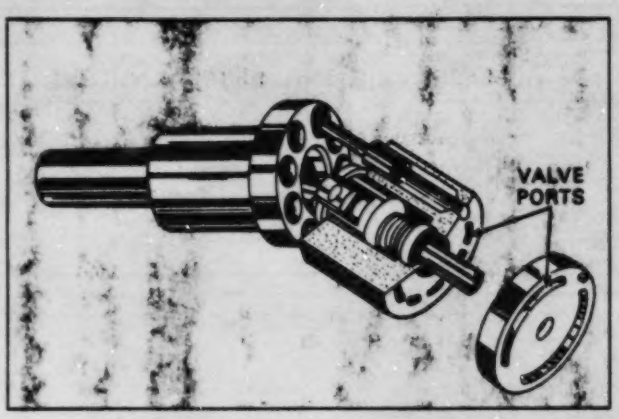
Check the student's performance in the following elements of maintaining fluid in the hydraulic system.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In draining the hydraulic system, the student:				
a. Relieved all hydraulic pressure and discharged the accumulator when needed	[ ]	[ ]	[ ]	[ ]
b. Drained the system following the manufacturer's specifications and recommendations	[ ]	[ ]	[ ]	[ ]
c. Flushed the hydraulic system with recommended fluid	[ ]	[ ]	[ ]	[ ]
d. Prevented cleaning solvent from coming in contact with seals and packings	[ ]	[ ]	[ ]	[ ]
e. Reinstalled well-cleaned filters or installed the new filters following the service manual procedure	[ ]	[ ]	[ ]	[ ]
f. Refilled the hydraulic system with correct oil	[ ]	[ ]	[ ]	[ ]
g. Prevented any foreign material from entering the system	[ ]	[ ]	[ ]	[ ]
h. Started the engine, warmed the system, and ran equipment through working cycle 4–5 times to bleed air from the system	[ ]	[ ]	[ ]	[ ]
i. Rechecked the oil level	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 43



Internal parts of a bent-axis, axial-piston, constant-flow pump.

Courtesy of the American Association for Vocational Instructional Materials

Servicing a Hydraulic Pump

Tractor Mechanics

Objective nos. 54,57,59,153

INTRODUCTION

The hydraulic pump, the most important part of the hydraulic system, converts the mechanical force of the engine into hydraulic fluid power by creating a flow of fluid. The fluid moves through the entire system, causing it to operate. When defects occur in the pump, it is vitally important that repairs and service be made correctly to insure an efficient, reliable system. In this learning activity package you will learn to service and repair a designated hydraulic pump.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Package 41, "Testing the Hydraulic System," and Package 42, "Maintaining Fluid in the Hydraulic System."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, find the Learning Activities inside this package and go through them in the order in which the are listed.

OBJECTIVE

Given the manufacturer's service manual, a clean working area, a set of mechanic's tools, a micrometer, torque wrench, replacement parts, hydraulic fluid, a dial indicator, solvents, and clean rags, service a hydraulic pump. There should be no damage to any parts. No dirt, lint or chaff should enter the system and the repaired pump must operate according to the manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 2, pp. 1 through 13.

(or) _____

2 STUDY the samples of the three types of pumps provided by the instructor.

(or) _____

3 READ Instructions, SERVICING A HYDRAULIC PUMP.

(or) _____

4 CHECK YOUR KNOWLEDGE of hydraulic pumps by taking student Self-Check I, UNDERSTANDING HYDRAULIC PUMPS.

5 READ the section on the hydraulic pump in the manufacturer's service manual for the designated tractor.

(or) The I & T Shop Manual

6 OBSERVE another student as he or she satisfactorily services a hydraulic pump and is checked out on this package.

(or) _____

7 PRACTICE servicing a hydraulic pump. Follow the procedure outlined in Learning Activity 3 and the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the Check-Out Activity on page 5.

TOOLS AND EQUIPMENT NEEDED

Micrometer
Mechanic's tool kit
Torque wrench
Dial indicator

MATERIALS AND SUPPLIES NEEDED

Hydraulic fluid
Cleaning solvent and rags
A Manufacturer's Service Manual

SAFETY

Follow standard safety procedures.

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
UNDERSTANDING HYDRAULIC PUMPS

Answer the following:

1. Hydraulic pumps convert _____ force into _____ power.

2. A hydraulic pump creates flow, not pressure. (True or False)

3. Hydraulic pumps work on a principle called displacement. The two types of displacement are _____ and _____.

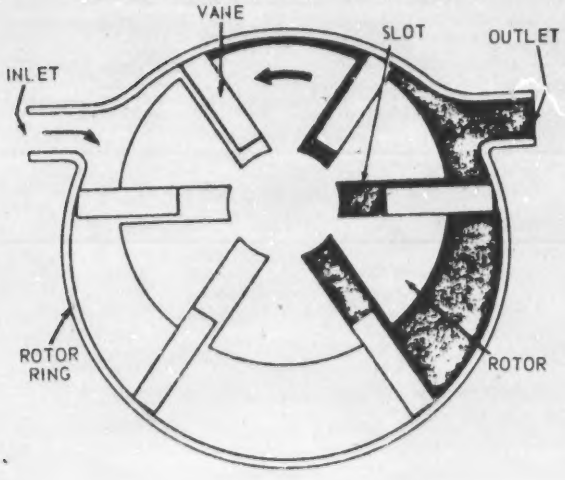
4. Which type of displacement is used in modern hydraulic pumps?

   Why?

5. The three types of hydraulic pumps are _____, _____ and _____.

6. What are the differences between an external gear pump and an internal gear pump?

7. Label the following sketches as to whether they are balanced or unbalanced vane pumps.



a. _____

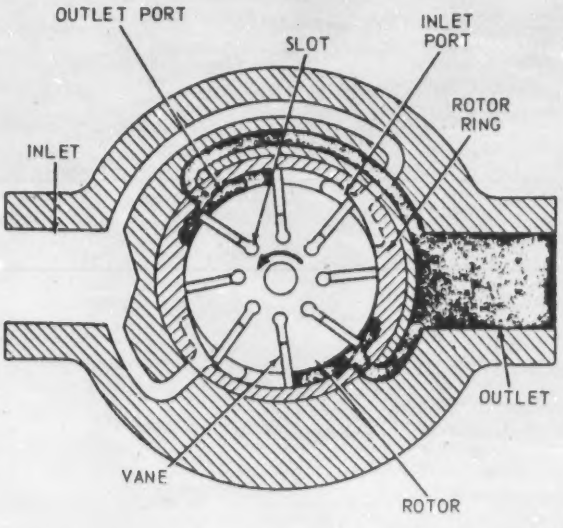
8. If the pistons of a piston pump are mounted in lines parallel with the pump's axle, it is a _____ piston pump.

9. If the pistons of a piston pump are set perpendicular to the pump's center, it is a _____ piston pump.

10. The swashplate in a piston pump can be stationary or movable. (True or False)

CORRECT RESPONSES

1. Mechanical, hydraulic
2. True
3. Positive and non-positive
4. Positive, provides a full flow or fluid through the system by preventing feedback
5. Vane, gear, and piston
6. Internal pump has two gears – one positioned and inside the other.
   External pump has two gears positioned in mesh with each other.
7. a. Unbalanced
   b. Balanced
8. Axial piston pump
9. Radial piston pump
10. True



b. _____

INSTRUCTIONS

SERVICING A HYDRAULIC PUMP

Hydraulic pumps have three basic designs:

1. Gear pumps

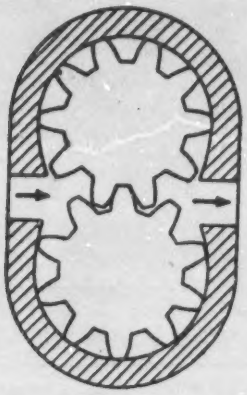


Figure 1. Gear pump – external type.

2. Vane pumps

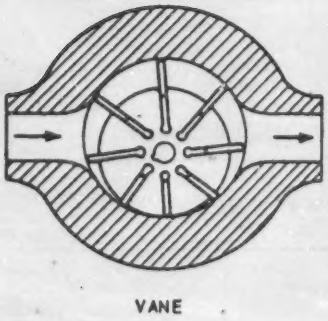


Figure 2. Vane pump – unbalanced type.

3. Piston pumps

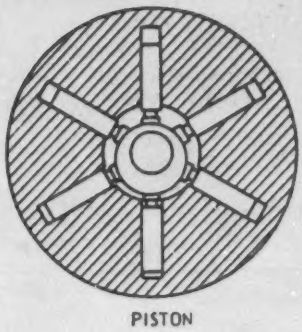


Figure 3. Piston pump – radial type.

Follow these steps in servicing a hydraulic pump:

1. Check the manufacturer's service manual for specific instructions on service and repair.
2. Remove pump from tractor following manufacturer's service manual.
3. Disassemble the hydraulic pump according to manufacturer's service manual.
4. Clean and inspect all parts replacing any worn or damaged parts.
5. Reassemble pump replacing seals and gaskets according to manufacturer's instructions.
6. Reinstall pump in hydraulic system on tractor.
7. Replace fluid and check pump, making adjustments if needed.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A HYDRAULIC PUMP.

Service the designated hydraulic pump.

DO NOT WRITE ON THIS PAGE

LAP TM–43

Student _____

Date _____

SERVICING A HYDRAULIC PUMP

Instructor's Final Checklist

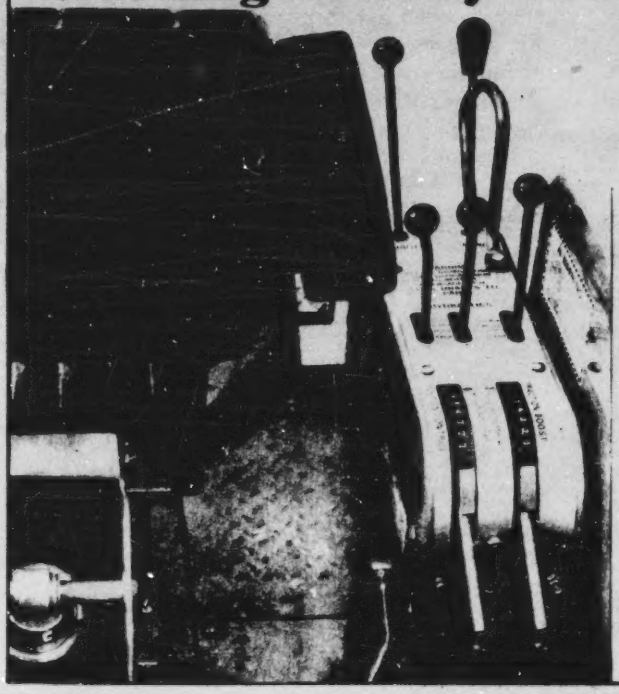
Check the student's performance in the following elements of servicing a hydraulic pump.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing a hydraulic pump, the student:				
a. Removed and disassembled the hydraulic pump from the tractor according to the manufacturer's instructions	[ ]	[ ]	[ ]	[ ]
b. Cleaned and inspected all parts	[ ]	[ ]	[ ]	[ ]
c. Replaced any parts that were worn or damaged	[ ]	[ ]	[ ]	[ ]
d. Reassembled the pump, replacing specified seals and gaskets	[ ]	[ ]	[ ]	[ ]
e. Reinstalled the pump and made necessary adjustments	[ ]	[ ]	[ ]	[ ]
2. The pump operated according to the manufacturer's specifications	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 44



Servicing Hydraulic Valves and Fittings

Tractor Mechanics

Objective nos. 151,159

Courtesy of John Deere and Company

INTRODUCTION

Worn hydraulic valves and leaky fittings are the most common causes of a hydraulic system malfunction. Some valves may have to be replaced, but most often they can be serviced with minimum expense. Hoses may also need replacement, but in most cases, new fittings are all that is needed. In this learning activity package you will learn how to service hydraulic valves and fittings.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Package 41, "Testing the Hydraulic System," and Package 42, "Maintaining Fluid in the Hydraulic System."

If you have completed these Learning Activity Packages, read the objectives below. If you feel you are already able to perform these tasks, read the Check-Out Activities on page 5 of this package. Then, either arrange with your instructor about doing the Check-Out Activities,

or,

If you need to complete learning activities in order to be able to do the tasks, find the Learning Activities inside this package and go through them in the order in which they are listed.

OBJECTIVES

(1) Using a designated tractor, correct wrenches, a service manual, a micrometer, a hand hydraulic pump with pressure gauge, fittings to attach pump to the valve, hydraulic fluid, repair parts, and clean rags, service and repair hydraulic valves on the designated tractor. The work area must be clean and when service is completed, hydraulic circuits should work within 10% of the manufacturer's specifications.

(2) Given a new fitting, the necessary tools and replacement parts, hydraulic fluid and oil, replace a hydraulic fitting. It should be replaced so that it does not leak under operating pressure.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 3, pp. 1 through 19.

(or) _____

2 CHECK YOUR KNOWLEDGE of hydraulic valves by answering the questions in Chapter 3, on page 19 of *Fundamentals of Service: Hydraulics* (John Deere & Company). Then compare your answers with those provided.

3 READ Instructions A, SERVICING HYDRAULIC VALVES.

(or) _____

4 STUDY *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 8, pp. 8 through 10.

5 READ Instructions B, SERVICING HYDRAULIC FITTINGS.

(or) _____

6 CONSULT the manufacturer's service manual for disassembly and reassembly of valves and fittings.

(or) The I & T Shop Manual

7 LOCATE the defective valve and leaky fitting on the designated tractor.

(or) _____

8 EXAMINE samples of hydraulic valves and fittings provided by the instructor.

(or) _____

9 PRACTICE servicing the sample valves and fittings. Follow the procedure outlined in Learning Activities 3 and 5 and the manufacturer's service manual.

10. ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES listed on page 5.

TOOLS AND EQUIPMENT NEEDED

Hand hydraulic pump with pressure gauge
Fitting necessary to attach pump
Mechanic's tool kit
Repair parts
New fittings

MATERIALS AND SUPPLIES

Hydraulic fluid
Repair parts
Clean rags

SAFETY

Make sure pressure is relieved before disassembly. Make sure lines and fittings are secure before testing.

INSTRUCTIONS

A—SERVICING HYDRAULIC VALVES

There are three major types of valves: (1) pressure control valves, (2) directional control valves, and (3) volume control valves. Check the manufacturer's service manual for the type that you have. Use the following procedure to service hydraulic valves:

1. Clean the valve and surrounding areas, making sure not to get the solvent or steam into the system.
2. Remove all pressure from system, allowing the equipment to rest on blocks on the shop floor.
3. Remove valve unit from system according to manufacturer's instructions and place it on a clean working area; make sure no dirt enters the unit.
4. After valve unit is removed, be sure to plug the lines to prevent dirt from entering the system.
5. Disassemble the valve, following manufacturer's instruction. Make sure all parts are identified for reassembly. (CAUTION: On spring loaded valves a press must be used to remove back up plug.)

6. Clean all valve components with a clean mineral oil solvent and dry them with compressed air to keep lint out of the reassembled hydraulic system.

7. Coat cleaned parts immediately with a rust inhibiting hydraulic oil.

8. Check all parts for cracks, scratches, and straightness. Make sure that end sealing surfaces are smooth and that no burrs are present. Polish surfaces lightly with emery cloth if necessary.

9. Replace any worn or damaged parts.

10. Install new sealing rings and reassemble valve, making sure no dirt is present on any components.

11. Check valve with hand hydraulic pump.

12. If valve checks out, reinstall it on the hydraulic system and operate system to see that all circuits are working correctly.

13. If valve does not check out, then either rework or replace the valve.

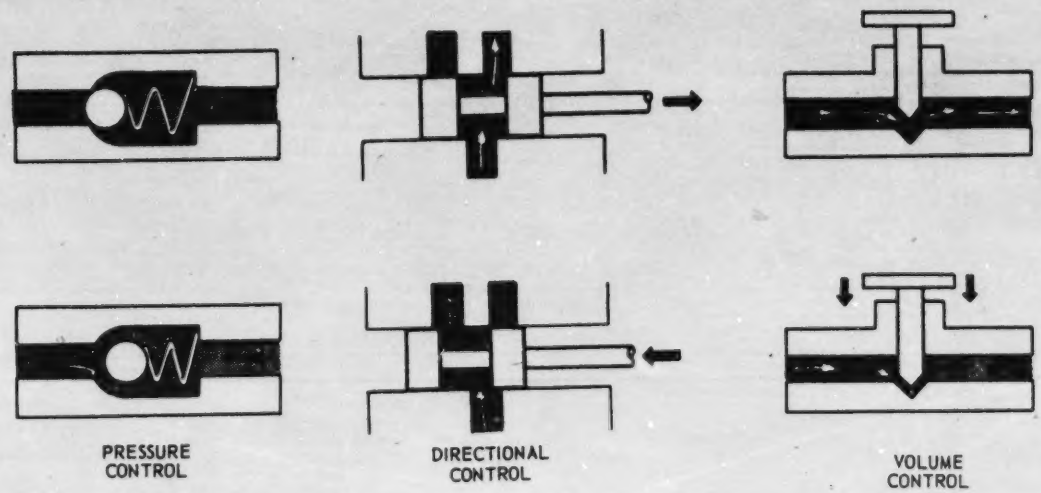


Figure 1. The Three Types of Valves

Courtesy of John Deere and Company

INSTRUCTIONS

B—SERVICING HYDRAULIC FITTINGS

Hose fittings may be permanent or reusable. Permanent fittings must be installed with the aid of a hose crimping machine. Reusable fittings can be installed with an ordinary vise. The following instructions apply to replacing old fittings with reusable fittings:

1. Carefully check to be sure that the fitting is the problem and that air is not coming from other locations.
2. Remove the pressure from the system.
3. With suitable wrench, remove line or hose from fitting, plugging lines to prevent dirt from entering system.
4. Remove fitting, checking for cause of leakage.
5. Check threads, flanges and flairs for burrs or nicks which could cause damage to new fitting.
6. Select new fitting that is identical to old fitting in size, thread and type.
7. Where needed, install sealing "0" ring on fitting, being careful not to cut it on the threads.
8. Install fitting to correct tightness. If a lock nut is used, install to correct angle and tighten lock nut.
9. Install line to fitting to be sure it is free and has no twist or bend.
10. Tighten line down, making sure that the sealing flange does not turn. Tighten, but do not over-torque.
11. Operate system and see if the leak has been stopped.
12. Refill the hydraulic system to desired level.

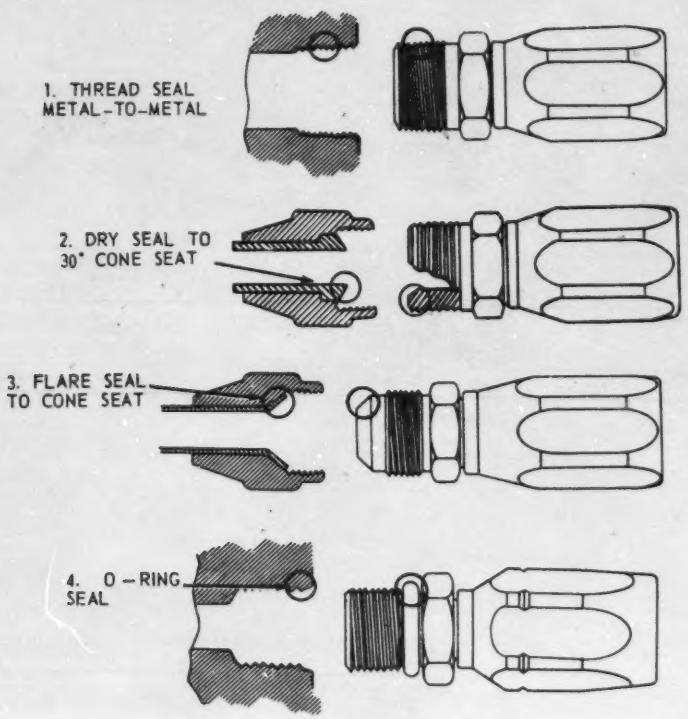


Figure 2. Four Major Ways of Sealing Hose Fittings
Courtesy of John Deere and Company

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING HYDRAULIC VALVES

1. List three major types of valves:

   a. _____

   b. _____

   c. _____

2. What major items should be checked when inspecting a valve?

   a. _____

   b. _____

   c. _____

   d. _____

3. List at least two functions of pressure control valves.

   a. _____

   b. _____

4. List three types of directional control valves:

   a. _____

   b. _____

   c. _____

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statements below explain the activities you must be able to complete in order to finish this learning activity package. As you go through each activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING HYDRAULIC VALVES AND FITTINGS.

On the Designated tractor:

Service and repair the hydraulic valves.

Replace a hydraulic fitting.

CORRECT RESPONSES

1. a. pressure control valves
   b. directional control valves
   c. volume control valves

2. a. clogging at orifice
   b. burring at ports
   c. scoring of spool
   d. weak spring

3. limits pressure
   reduces pressure
   sets pressure for circuit entry
   unloads pump

4. a. check valves
   b. rotary valves
   c. spool valves

DO NOT WRITE ON THIS PAGE

LAP TM–44

Student _____

Date _____

SERVICING HYDRAULIC VALVES AND FITTINGS

Instructor's Final Checklist

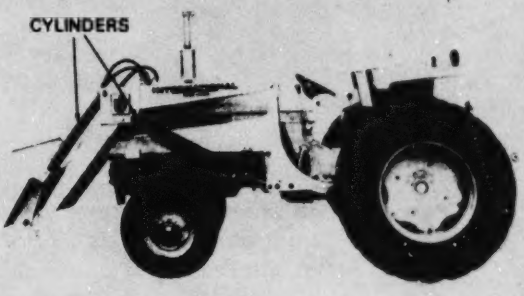
Check the student's performance in the following elements of servicing hydraulic valves and fittings.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	In servicing the hydraulic system, the student:				
	a. Cleaned and removed defective valve from system	[ ]	[ ]	[ ]	[ ]
	b. Disassembled valve according to manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
	c. Cleaned valve components	[ ]	[ ]	[ ]	[ ]
	d. Coated clean parts with rust inhibiting hydraulic oil	[ ]	[ ]	[ ]	[ ]
	e. Replaced worn parts and reassembled valve	[ ]	[ ]	[ ]	[ ]
	f. Checked valve with hand hydraulic pump	[ ]	[ ]	[ ]	[ ]
	g. Replaced valve in system	[ ]	[ ]	[ ]	[ ]
2.	All circuits of hydraulic system functioned properly	[ ]	[ ]	[ ]	[ ]
3.	In servicing fittings, the student:				
	a. Removed pressure from system	[ ]	[ ]	[ ]	[ ]
	b. Replaced old fitting with new fitting	[ ]	[ ]	[ ]	[ ]
	c. Operated system to check for leaks	[ ]	[ ]	[ ]	[ ]
4.	The system did not leak	[ ]	[ ]	[ ]	[ ]
5.	No dirt entered the hydraulic system	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 45



Courtesy of John Deere and Company

Servicing Hydraulic Cylinders

Tractor Mechanics

Objective no. 149

INTRODUCTION

The true "work horse" of the hydraulic system is the hydraulic cylinder. It must change the fluid power of the pump back to mechanical power to do the work required. Because it receives pressure from the equipment load as well as from the hydraulic fluid, it is very susceptible to such damage as bent piston rods, loose mountings, lack of lubrication, intake of air, burrs on working parts, and leakage of hydraulic fluid. If not taken care of, these can become major problems and result in expensive replacement of the entire cylinder. In this learning activity package you will learn how to avoid major problems by servicing a hydraulic cylinder.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Package 41, "Testing the Hydraulic System," and Package 42, "Maintaining Fluid in the Hydraulic System."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, find the Learning Activities inside this package and go through them in the order in which they are listed.

OBJECTIVE

Given a hydraulic tester, a manufacturer's service manual, replacement parts, necessary tools, and lubricants, repair a hydraulic cylinder. All parts should be clean and correctly lubricated. There should be no damage to parts. New seals should be installed where needed, and the hydraulic tester must indicate that the system functions according to specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 4, pp. 1 through 8.

(or) _____

2 VIEW slide-tape presentation TM–45, "Servicing a Hydraulic Cylinder."

(or) _____

3 CHECK YOUR KNOWLEDGE by answering the questions in *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 4, p. 8.

4 EXAMINE the two types of cylinders supplied by the instructor.

(or) _____

5 READ Instructions, SERVICING A HYDRAULIC CYLINDER.

(or) _____

6 STUDY the section on the hydraulic cylinder in the manufacturer's service manual for the designated tractor.

7 PRACTICE servicing a hydraulic cylinder on the designated tractor or on one on display.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES on page 4.

TOOLS AND EQUIPMENT NEEDED

Hydraulic tester
Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Recommended lubricants
Seals
Mineral oil
Crocus cloth

SAFETY

Make sure oil connections are secure when system is pressurized. Make sure pressure is released before disassembly.

INSTRUCTIONS

SERVICING A HYDRAULIC CYLINDER

There are two main types of hydraulic cylinders–the piston type, which gives straight movement, and the vane type, which gives rotary movement. Check the manufacturer's service manual for specifics and variations, as well as for repair instructions for your designated hydraulic pump. In general, you may use the following procedure to service your pump:

1. Test and diagnose the specific problem on a hydraulic testing machine, following instructions in the manufacturer's service manual and the instructions which come with the testing machine.

2. The following are possible causes of trouble and their cures:

   a. Outside leaks:
   –Tighten end caps.
   –Replace gasket.
   –Replace packing around piston rod.
   –Turn seal lip toward pressure oil.
   –Tighten mounting and pivot points to prevent damaged seals.
   –Replace piston rods if misaligned.
   –Check and correct piston rod lubrication, if necessary.
   –Check for damage due to dirt.

b. Internal leaks:
   —Replace piston seals or rings.
   —Check cylinder walls for scoring caused by grit in oil, and repair if necessary.

c. Cylinder creeping:
   —Check for internal leaks.
   —Replace control valve.

d. Sluggish operation:
   —Check for internal leaks.
   —Check for air in cylinder.
   —Check for oil of too high velocity.
   —Test for worn parts.

e. Loose mounting:
   —Check pivot points and mounts.

f. Misalignment:
   —See if piston rods are galled or bent.
   —Check packing.

g. Lack of lubrication:
   —Check piston rods.

h. Abrasives or rods:
   —Clean out grit; replace seals.
   —Check rods for rust and repair.

i. Burrs on piston rod:
   —Clean with crocus cloth.
   —Replace seal.

j. Air vents:
   —Change filters.

3. Check service manual for other causes of malfunction for specific system.

4. Relieve pressure from the system and remove the cylinder.

5. Disassemble the cylinder according to the manufacturer's service manual.

6. Clean and lubricate all usable parts.

7. Replace all worn parts with lubricated new parts. (CAUTION: Clean parts with a mineral oil solvent and dry them with compressed air. No dirt or lint should be present on reassembled parts.)

8. Reassemble the cylinder and place it on system, bleeding the air from the cylinder.

9. Check out system on the hydraulic tester again, and adjust as indicated.

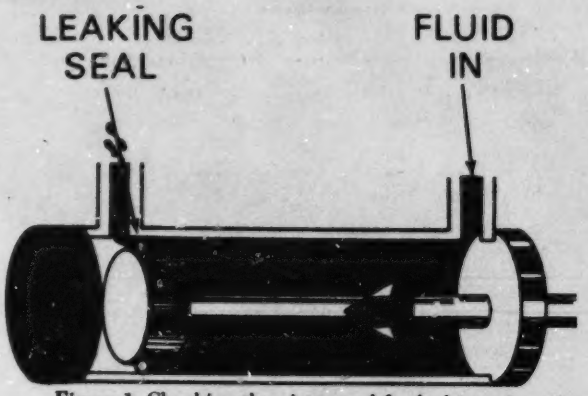


Figure 1 Checking the piston rod for leaking when the rod is retracted in a double-acting cylinder.

Courtesy of the American Association for Vocational Instructional Materials

57

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING HYDRAULIC CYLINDERS

Answer the following:

1. List the two major types of hydraulic cylinders:

   a. _____

   b. _____

2. List at least two "cures" for each of the following hydraulic cylinder "ailments":
   a. outside leaks

      1. _____ 2. _____

   b. internal leaks

      1. _____ 2. _____

   c. cylinder creeping

      1. _____ 2. _____

   d. sluggish operation

      1. _____ 2. _____

3. List the two major types of piston - type cylinders:

   a. _____

   b. _____

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CORRECT RESPONSES

1. a. piston type
   b. vane type

2. a. tighten end caps
   replace gaskets
   b. replace piston seals or rings
   check cylinder walls for scoring and
   repair if necessary
   c. check for internal leaks
   replace control leaks
   d. check for internal leaks
   check for air in cylinder

3. a. single acting
   b. double acting

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A HYDRAULIC CYLINDER.

Service a hydraulic cylinder on the designated hydraulic system.

DO NOT WRITE ON THIS PAGE

LAP TM--45

Student _____

Date _____

SERVICING A HYDRAULIC CYLINDER

Instructor's Final Checklist

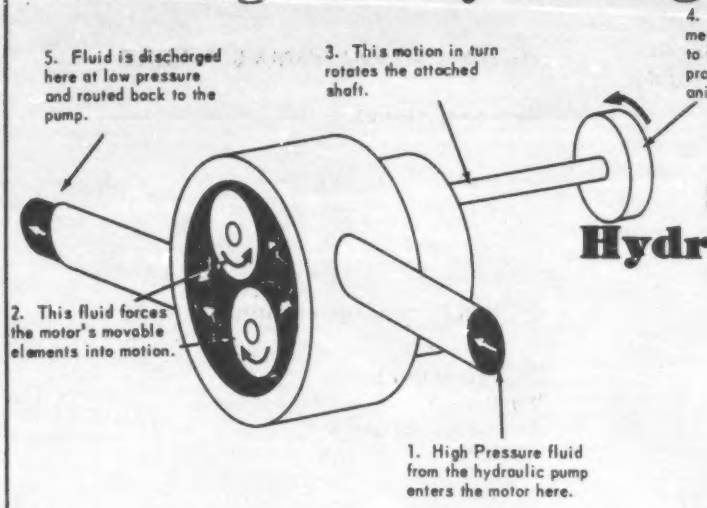
Check the student's performance in the following elements of servicing a hydraulic cylinder.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

		Student Performance			
		Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1.	The student tested the cylinder with a hydraulic tester and diagnosed the specific problem of the cylinder	[ ]	[ ]	[ ]	[ ]
2.	The student removed the cylinder from the designated system and disassembled it according to the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
3.	All usable parts were cleaned and lubricated	[ ]	[ ]	[ ]	[ ]
4.	Worn parts were replaced with new, lubricated parts	[ ]	[ ]	[ ]	[ ]
5.	The student reassembled cylinder and returned it to the system according to the manufacturer's service manual	[ ]	[ ]	[ ]	[ ]
6.	The cylinder was bled properly	[ ]	[ ]	[ ]	[ ]
7.	The student checked out the system with the tester to see if the problem was corrected	[ ]	[ ]	[ ]	[ ]
8.	The system functioned according to specifications	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 46


5. Fluid is discharged here at low pressure and routed back to the pump.
3. This motion in turn rotates the attached shaft.
4. The shaft is mechanically linked to the work load and provides rotary mechanical motion.
2. This fluid forces the motor's movable elements into motion.
1. High Pressure fluid from the hydraulic pump enters the motor here.

Basic Operation of Hydraulic Motor

Servicing Hydraulic Motors

Tractor Mechanics

Courtesy of John Deere and Company

Objective no. 155

INTRODUCTION

A hydraulic motor is designed much like a hydraulic pump. The pump drives the fluid, while the motor is driven by the fluid. Because hydraulic motors are similar to hydraulic pumps, the problems associated with their failure are basically the same as those associated with hydraulic pump failure. Some of the problems are improper fluid, poor operation or system design, and poor maintenance or incorrect motor selection. In this learning activity package you will learn how to solve these problems by properly servicing a hydraulic motor.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Package 41, "Testing the Hydraulic System," and Package 42, "Maintaining Fluid in the Hydraulic System."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, find the Learning Activities inside this package and go through them in the order in which they are listed.

OBJECTIVE

Given the manufacturer's service manual, the necessary tools and replacement parts, and fresh oil, service a hydraulic motor. The disassembly and reassembly should follow the manufacturer's instructions. All parts will be cleaned, and worn or damaged parts will be replaced with those recommended by the manufacturer. The pressure, speed, torque, displacement, load,and temperature should be adjusted to the manufacturer's specifications.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Hydraulics* (Deere & Company), Chapter 5, pp. 1 to 12.

(or) _____

2 COMPARE Figure 3 in Chapter 5, p. 2 with Figure 4 in Chapter 2 p. 2 in *Fundamentals of Service: Hydraulics* (Deere & Company).

(or) _____

3 READ Instructions, SERVICING A HYDRAULIC MOTOR.

(or) _____

4 CHECK YOUR KNOWLEDGE of hydraulic motors by taking Student Self-Check I, SERVICING A HYDRAULIC MOTOR.

5 EXAMINE the three types of motors provided by the instructor.

(or) _____

6 STUDY the section on the hydraulic motor in the manufacturer's service manual for the designated tractor.

(or) The I & T Service Manual

7 PRACTICE servicing a hydraulic motor. Follow the procedure outlined in Learning Activity 3 and the manufacturer's service manual.

8 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES on page 4.

TOOLS AND EQUIPMENT NEEDED

Mechanic's tool kit

MATERIALS AND SUPPLIES

Hydraulic fluid
Mineral oil
Replacement parts

SAFETY

Make sure pressure is relieved before removing motor.

71

INSTRUCTIONS

SERVICING A HYDRAULIC MOTOR

There are three basic types of hydraulic motors: (1) vane motors, (2) gear motors, and (3) piston motors. There are also variations on these three types. Gear motors have two basic designs: external and internal. Piston motors also come in two basic designs: axial and radial. Vane motors may be one of two kinds: balanced or unbalanced. Check the manufacturer's service manual for type and service instructions.

To service a hydraulic motor, the following procedure should be used:

1. Trouble shoot the motor following instructions in the service manual to detect causes of:
   a. Motor failing to operate
   b. Motor operating slowly
   c. Motor operating erratically
   d. Motor turning in wrong direction
   e. Motor shaft not turning
2. Follow instructions in the service manual to reach and remove the designated hydraulic motor.
3. Disassemble motor following service manual instructions, making sure you identify all parts.
4. Clean all parts using a mineral oil solvent and then dry them with compressed air to avoid collecting dirt or lint on parts. Lubricate parts to prevent them from rusting.
5. Inspect parts and replace any damaged or worn parts.
6. Reassemble in the order specified in the service manual, checking lines and connections for air and fluid leaks, and installing new seals and gaskets.
7. Replace old oil and operate motor, adjusting for specified pressure, speed, torque, displacement, load, and temperature.

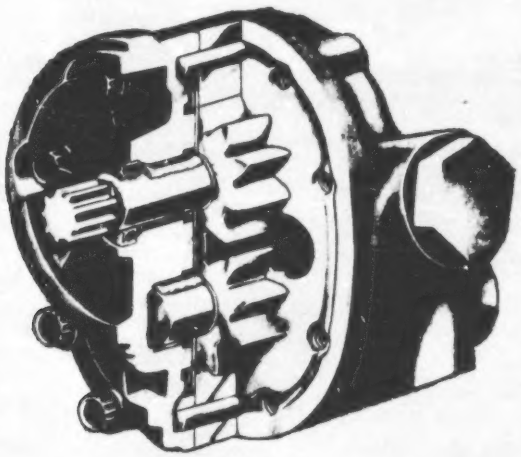


Figure 1. A cutaway view of an external gear type motor.

Courtesy of the American Association for Vocational Instructional Materials

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
SERVICING A HYDRAULIC MOTOR

1. What are the three basic types of hydraulic motors?
   a.
   b.
   c.

2. How does the hydraulic pump differ from the hydraulic motor?

3. The hydraulic motor converts a _____ force into a _____ force.

4. A pump can generally be used as a motor. (True or False)

5. What is meant by "torque" of a motor?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITY

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A HYDRAULIC MOTOR.

Service a hydraulic motor on the designated hydraulic system.

CORRECT RESPONSES

1. a. vane motors b. gear motors
   c. piston motors
2. The hydraulic motor works in reverse when compared to a pump. The pump draws in fluid and pushes it out, on the other hand, the motor has fluid forced in, but exhausts it out. The pump drives its fluid, while the motor is driven by its fluid.
3. a. fluid b. mechanical
4. False. It takes some changeover. To avoid trouble, use pumps as pumps and motors as motors.
5. Torque is a measure of the turning force exerted at the outer edge of the motor drive shaft.

DO NOT WRITE ON THIS PAGE

LAP TM–46

Student _____

Date _____

SERVICING A HYDRAULIC MOTOR

Instructor's Final Checklist

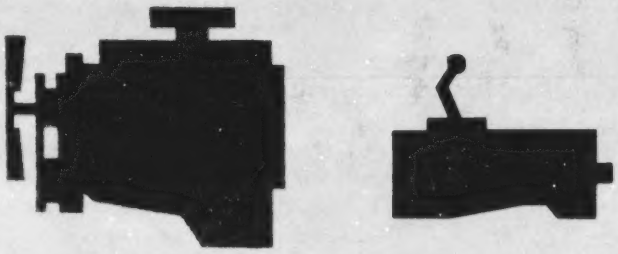
Check the student's performance in the following elements of servicing a hydraulic motor.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
1. In servicing the hydraulic motor, the student:				
a. Used trouble-shooting instructions in manufacturer's service manual to determine problems	[ ]	[ ]	[ ]	[ ]
b. Followed manufacturer's instructions for removal and disassembly of motor	[ ]	[ ]	[ ]	[ ]
c. Identified, cleaned, dried, and lubricated all usable parts	[ ]	[ ]	[ ]	[ ]
d. Replaced any damaged or worn parts	[ ]	[ ]	[ ]	[ ]
e. Reassembled motor according to manufacturer's instructions and refilled motor with fresh oil	[ ]	[ ]	[ ]	[ ]
f. Operated the motor and made specified adjustments for pressure, speed, torque, displacement, load, and temperature	[ ]	[ ]	[ ]	[ ]
2. The motor was free of leaks and was adjusted correctly when the student completed the service operation.	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 47



Hydraulic Assist Transmission in a Complete Power Train

Courtesy of John Deere and Company

Servicing Hydraulic Assist Transmissions

Tractor Mechanics

Objective nos. 148, 152, 160

INTRODUCTION

A hydraulic assist transmission is a train of gears which can be shifted without interrupting the flow of power. The gears are kept in constant mesh and two or more hydraulic clutches engage and disengage the gears while the tractor is moving. Because two different, complex systems work together as one, many minor problems can develop to cause breakdowns, wear, and excessive damage. Proper servicing of these minor problems will prevent major problems. In this learning activity package you will learn how to properly service a hydraulic-assist transmission.

DIRECTIONS

Before you start work on this learning activity package, be sure you have completed Package 41, "Testing the Hydraulic System," and Package 42, "Maintaining Fluid in the Hydraulic System."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, find the Learning Activities inside this package and go through them in the order in which they are listed.

OBJECTIVE

Given the manufacturer's service manual, the necessary tools, testing equipment, replacement parts, fresh oil, and lubricants, service a hydraulic-assist transmission. All parts must be disassembled and reassembled according to manufacturer's instructions. There should be no damage to any parts. Replacement parts will be those specified by the manufacturer, and the system should function to specifications.

LEARNING ACTIVITIES

1 STUDY *Fundamentals of Service: Power Trains* (Deere & Co.), Chapter 4 pp. 1 to 11.

(or) _____

2 CHECK YOUR KNOWLEDGE of hydraulic-assist transmissions by answering the questions at the end of Chapter 4, p. 12, of *Fundamentals of Service: Power Trains* (Deere & Company). Compare your answers with the correct responses.

3 CONSULT the manufacturer's service manual to determine the type of hydraulic-assist transmission and the troubleshooting procedure for the designated tractor.

(or) The I & T Shop Manual

4 CONSTRUCT a troubleshooting chart using the example in Chapter 4, p. 11, of *Fundamentals of Service: Power Trains* (Deere and Company).

(or) _____

5 READ Instructions, SERVICING A HYDRAULIC-ASSIST TRANSMISSION.

(or) _____

6 PRACTICE servicing a hydraulic-assist transmission following the procedure in Learning Activity 5.

7 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES on page 4.

TOOLS AND EQUIPMENT NEEDED

Test equipment
Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Replacement parts
Hydraulic fluid

SAFETY

Make sure tractor is secure when removing transmission.

INSTRUCTIONS

SERVICING A HYDRAULIC-ASSIST TRANSMISSION

In servicing a hydraulic-assist transmission, the following procedure should be used:

1. Troubleshoot the hydraulic-assist transmission following instructions in the manufacturer's service manual to determine if repairs are needed in the clutches or the gear trains.
2. Remove all parts necessary to reach the transmission according to the manufacturer's instructions.
3. Disassemble transmission following instructions in the service manual, noting location of parts.
4. Clean and inspect parts for wear and/or damage. Repair or replace parts as needed.
5. After the parts have been cleaned, coat them with oil to keep them from rusting.
6. Take all necessary precautions to keep hydraulic system free of dirt and lint.
7. Reassemble transmission in the order specified in the service manual and install new seals.
8. Check out system as specified in the service manual and make adjustments if indicated.

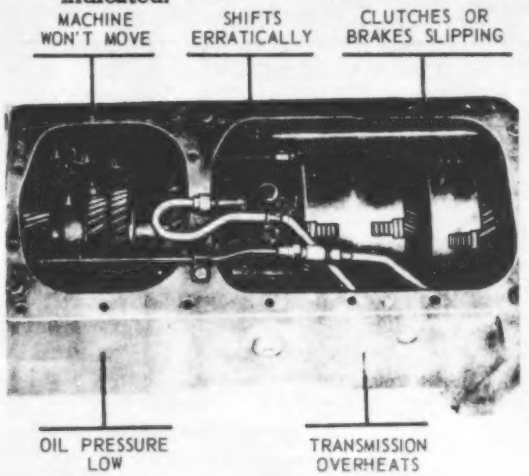


Figure 1. Trouble Shooting Problems with Hydraulic Assist Transmissions

Courtesy of John Deere and Company

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
HYDRAULIC - ASSIST TRANSMISSIONS

1. Must tractors equipped with hydraulic-assist transmissions be stopped before shifting?

2. The gear train on a hydraulic-assist transmission usually takes two forms, they are: _____and _____

3. In a hydraulic-assist transmission, the disks are splined to the_____, and the plates are splined to the_____.

4. To engage a gear, the fluid engages a pack of friction disks and plates called a _____ _____.

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

CHECK-OUT ACTIVITIES

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A HYDRAULIC-ASSIST TRANSMISSION.

Service the hydraulic-assist transmission on the designated tractor.

CORRECT RESPONSES

1. No
2. Countershaft
   Planetary
3. Input drum
   Output hub
4. Hydraulic clutch

DO NOT WRITE ON THIS PAGE

LAP TM–47

Student _____

Date _____

SERVICING A HYDRAULIC-ASSIST TRANSMISSION

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a hydraulic-assist transmission.

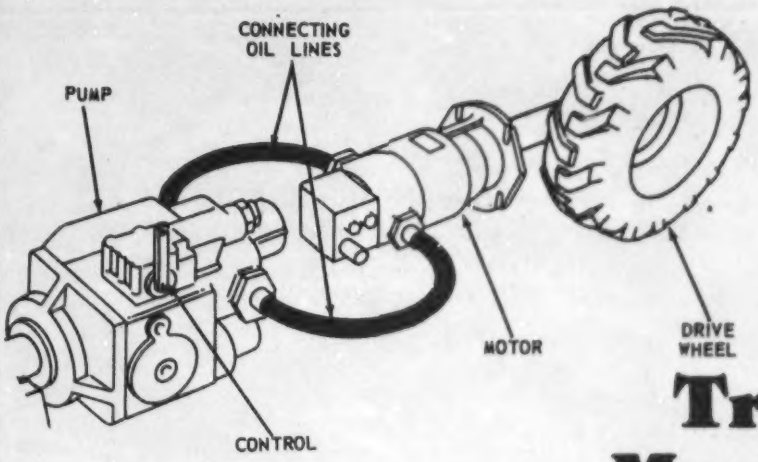
Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing a hydraulic-assist transmission, the student:				
1. Followed troubleshooting procedure specified in manufacturer's instructions to locate the specific problem	[ ]	[ ]	[ ]	[ ]
2. Removed and disassembled transmission, keeping it free of dirt and lint	[ ]	[ ]	[ ]	[ ]
3. Cleaned, inspected, and lubricated all parts, replacing any worn or damaged parts	[ ]	[ ]	[ ]	[ ]
4. Reassembled transmission following manufacturer's instructions	[ ]	[ ]	[ ]	[ ]
5. Checked out the system and made any indicated adjustments	[ ]	[ ]	[ ]	[ ]
6. Made sure the system functioned according to manufacturer's specifications	[ ]	[ ]	[ ]	[ ]

Learning Activity Package Number 48

Servicing a Hydraulic Drive Pump and Motor



Courtesy of John Deere and Company

Tractor Mechanics

Objective no. 156

INTRODUCTION

In a hydraulic-drive transmission, fluid under pressure is used to transmit engine power to the drive wheels of the tractor. The system is composed of a pump which converts engine power (mechanical power) to hydraulic power, and a motor which changes the hydraulic power back into mechanical power (drive power). The pump-motor team is referred to as a hydrostatic transmission. If only a pump is used to turn a turbine, the hydraulic transmission is called a hydrodynamic transmission. In previous packages you learned how to service a hydraulic pump and motor in two different systems. In this learning activity package you will learn how to service the pump and motor on a larger scale as they work together to drive a tractor.

DIRECTIONS

Before you start to work on this learning activity package, be sure you have completed Package 41, "Testing the Hydraulic System," Package 42, "Maintaining Fluid in the Hydraulic System," Package 43, "Servicing a Hydraulic Pump," and Package 46, "Servicing a Hydraulic Motor."

If you have completed these Learning Activity Packages, read the objective below. If you feel you are already able to perform this task, read the Check-Out Activity on page 4 of this package. Then, either arrange with your instructor about doing the Check-Out Activity,

or,

If you need to complete learning activities in order to be able to do the task, find the Learning Activities inside this package and go through them in the order in which they are listed.

OBJECTIVE

Given the manufacturer's service manual, steam cleaning equipment, the necessary clean and grease-free tools, and supplies, parts and oil, service a hydrostatic drive pump and motor. All parts will be disassembled and reassembled following manufacturer's instructions. The working area and all parts must be clean. No dirt, lint, or chaff should enter the system, and the system should operate to the manufacturer's specifications with no leakage.

LEARNING ACTIVITIES

1 READ *Fundamentals of Service: Power Trains* (Deere & Company), Chapter 5, pp. 1 through 4.

(or) _____

2 CHECK YOUR KNOWLEDGE of hydraulic-drive pumps and motors by answering the questions at the end of Chapter 5 in *Fundamentals of Service: Power Trains.* Compare your answers with the correct responses.

3 STUDY Figures 10, 14, 15, and 16 in Chapter 5 of *Fundamentals of Service: Power Trains,* pp. 5, 7, 8 and 9.

(or) _____

4 REVIEW the pump and motor sample you studied in Package 43 and Package 46.

(or) _____

5 READ Instructions, SERVICING A HYDROSTATIC DRIVE.

(or) _____

6 CONSULT manufacturer's service manual for troubleshooting procedure, disassembly, and reassembly instructions, specified replacement parts, and recommended oil.

7 OBSERVE another student as he or she satisfactorily performs and is checked out on this package,

(or) _____

8 PRACTICE servicing a hydraulic-drive pump and motor on the designated tractor.

9 ARRANGE with your instructor to complete this learning activity package by going through the CHECK-OUT ACTIVITIES on page 4.

TOOLS AND EQUIPMENT NEEDED

Steam cleaner
Mechanic's tool kit

MATERIALS AND SUPPLIES NEEDED

Replacement parts
Hydrostatic pump oil

SAFETY

Make sure tractor is secure when removing hydrostatic drive pump and motor.

INSTRUCTIONS

SERVICING A HYDROSTATIC DRIVE

In servicing a hydrostatic drive, the following procedure should be used:

1. Using proper test equipment, follow the procedure outlined in the manufacturer's service manual to test the system and locate any problem areas.

2. Prior to disassembling the pump or motor, have ready:

   a. Several clean plastic plugs to seal openings when removing the lines or hoses.

   b. Several clean plastic bags to place over open ends of lines or hoses and rubber bands to secure the bags.

   c. A clean container of solvent and a compressed air unit to wash and dry internal parts.

   d. A clean container of transmission fluid to use on internal parts as they are reassembled.

   e. Petroleum jelly to lubricate surfaces where recommended in the service manual.

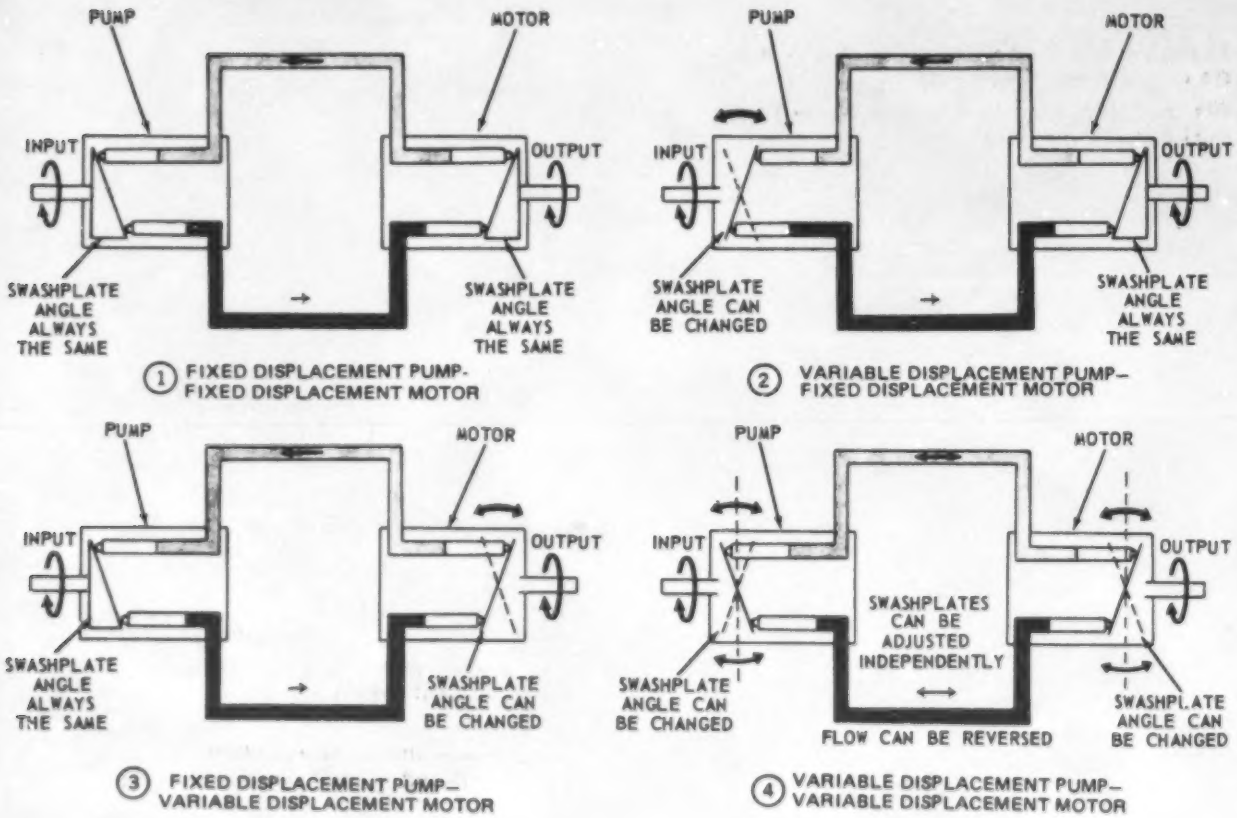
3. Disassemble following directions in the service manual.

4. Clean and inspect all parts, replacing worn or damaged parts as needed.

5. Reassemble following directions in the service manual. Install new O-rings, seals, and gaskets to seal mating parts and prevent leakage.

6. Replace oil supply and check for correct level.

7. Test the system following the procedure outlined in the service manual; make adjustments if needed.



Courtesy of John Deere and Company

Figure 1. Four types of pump and motor combinations commonly used in a hydrostatic drive.

STUDENT SELF CHECK
DO NOT WRITE ON THIS PAGE!
HYDRAULIC PUMPS AND MOTORS

Answer the following:

1. The three major parts of a hydrostatic drive are:

   a. _____

   b. _____

   c. _____

2. The two types of pumps are:

   a. _____

   b. _____

3. Why is it necessary to cover all openings and hose ends when taking them apart for service ?

Compare your answers with the correct responses at the bottom of this page. Review any incorrect answers before going on to the next learning activity.

The statement below explains the activity you must be able to complete in order to finish this learning activity package. As you go through the activity, your instructor will rate your performance using the Instructor's Final Checklist, SERVICING A HYDRAULIC-DRIVE PUMP AND MOTOR.

Service the designated hydrostatic drive system.

CORRECT RESPONSES

1. a. pump
   b. oil lines
   c. motor

2. a. fixed displacement pump
   b. variable displacement pump

3. to prevent dirt or dust particles from entering the system and causing wear on the parts

DO NOT WRITE ON THIS PAGE

LAP TM–48

Student _____

Date _____

SERVICING A HYDRAULIC-DRIVE PUMP AND MOTOR

Instructor's Final Checklist

Check the student's performance in the following elements of servicing a hydraulic-drive pump and motor.

Place an X in the appropriate box indicating not accomplished, partially accomplished, or fully accomplished. If, because of special circumstances, the item was impossible to complete, place an X in the "Not Applicable" box.

Performance Level: All items must receive a rating of FULLY ACCOMPLISHED (or Not Applicable). If any items are rated Not Accomplished or Partially Accomplished, the student and instructor will discuss this and decide which learning activities must be repeated.

	Student Performance			
	Not Applicable	Not Accomplished	Partially Accomplished	Fully Accomplished
In servicing a hydraulic drive pump and motor, the student:				
1. Tested the system to locate the problem	[ ]	[ ]	[ ]	[ ]
2. Disassembled the pump and motor according to the manufacturer's instructions	[ ]	[ ]	[ ]	[ ]
3. Cleaned, inspected, and lubricated all parts and replaced any worn or damaged parts	[ ]	[ ]	[ ]	[ ]
4. Installed new O-rings, seals, and gaskets	[ ]	[ ]	[ ]	[ ]
5. Reassembled pump and motor following manufacturer's instructions, and replaced them in the system	[ ]	[ ]	[ ]	[ ]
6. Prevented dirt, lint, and rust from entering the system	[ ]	[ ]	[ ]	[ ]
7. Adjusted the system to run at manufacturer's specifications	[ ]	[ ]	[ ]	[ ]